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FORM PTO-1390 (REV. 5-93) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTORNEY'S DOCKET NUMBER **2345/117**
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371	U.S. APPLICATION NO. (If known, see 37 CFR 1.5) **09/555662**

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/EP98/06911	21 October 1998 (21.10.98)	01 December 1997 (01.12.97)

TITLE OF INVENTION
METHOD AND DEVICE FOR TUNING THE WAVELENGTH OF AN OPTOELECTRONIC COMPONENT ARRANGEMENT

APPLICANT(S) FOR DO/EO/US
HILLMER, Hartmut and KLEPSER, Bernd

Applicant(s) herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)) immediately rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☒ has been transmitted by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US)
6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   b ☐ have been transmitted by the International Bureau.
   c. ☐ have not been made, however, the time limit for making such amendments has NOT expired.
   d ☒ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5))

Items 11. to 16. below concern other document(s) or information included:

11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☒ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A **FIRST** preliminary amendment.
    ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
14. ☐ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☒ Other items or information: International Search Report and International Preliminary Examination Report.

Express Mail No.: EM360466583US

U.S. APPLICATION NO. if known, see 37 C.F.R.1 5	INTERNATIONAL APPLICATION NO	ATTORNEY'S DOCKET NUMBER
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17. ☒ The following fees are submitted: | CALCULATIONS | PTO USE ONLY

Basic National Fee (37 CFR 1.492(a)(1)-(5)):

Search Report has been prepared by the EPO or JPO $840.00

International preliminary examination fee paid to USPTO (37 CFR 1.482) $670.00

No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)) $760.00

Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO $970.00

International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) $96.00

ENTER APPROPRIATE BASIC FEE AMOUNT =				$ 840.00	
Surcharge of $130.00 for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).				$	
Claims	Number Filed	Number Extra	Rate		
Total Claims	19 - 20 =	0	X $18.00	$	
Independent Claims	2 - 3 =	1	X $78.00	$	
Multiple dependent claim(s) (if applicable)			+ $260.00	$	
TOTAL OF ABOVE CALCULATIONS =				$840.00	
Reduction by 1/2 for filing by small entity, if applicable. Verified Small Entity statement must also be filed. (Note 37 CFR 1.9, 1.27, 1.28).				$	
SUBTOTAL =				$	
Processing fee of $130.00 for furnishing the English translation later the ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(f)). +				$	
TOTAL NATIONAL FEE =				$ 840.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). $40.00 per property +				$	
TOTAL FEES ENCLOSED =				$ 840.00	
				Amount to be: refunded	$
				charged	$

a. ☐ A check in the amount of $__________ to cover the above fees is enclosed.

b. ☒ Please charge my Deposit Account No. 11-0600 in the amount of $840.00 to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 11-0600. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

Richard L. Mayer

SIGNATURE By: Mary C. Werner Reg No. 30,333

SEND ALL CORRESPONDENCE TO:

Kenyon & Kenyon
One Broadway
New York, New York 10004

Richard L. Mayer, Reg. No 22,490
NAME

6/1/00
DATE

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[2345/117]

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT:	HILLMER, et al.
SERIAL NO.:	to be assigned
FILED:	herewith
TITLE:	METHOD AND DEVICE FOR TUNING THE WAVELENGTH OF AN OPTOELECTRONIC COMPONENT ARRANGEMENT
ART UNIT:	not yet known
EXAMINER:	not yet known

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

PRELIMINARY AMENDMENT

Please amend the above-identified application before a first consideration on the merits as follows:

IN THE DRAWINGS

Please replace Figs. 2a, 12a and 13 with the amended Figs. 2a, 12a and 13a and 13b submitted herewith.

IN THE TITLE

Please amend the title to read --METHOD AND ARRANGEMENT FOR WAVELENGTH TUNING OF AN OPTOELECTRONIC COMPONENT ARRAY--.

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IN THE SPECIFICATION

On page 1, line 1, change “Background of the Invention” to --Field of the Invention--.

On page 1, line 6, before “relates” insert --also-- and change “arrangement” to --array--.

On page 1, line 7, change “components. Each” to --components where each--.

On page 1, before line 11, insert --Related Technology--.

On page 2, before line 11, insert --Summary of the Invention--.

On page 2, line 11, change "The object" to --An object--, change "indicate" to --provide-- and after "method" insert --and device--.

On page 2, line 12, after "method" insert --and device-- and after "at" insert --low cost--.

On page 2, delete lines 13-14.

On page 2, line 16, change "The object of the present invention is achieved by a method that is likewise based on" to --The method and device according to the present invention employ--.

On page 2, delete lines 20-22.

On page 2, line 23, before "wavelength" insert --In the method according to the present invention the--.

On page 3, line 18, delete "very".

On page 3, line 23, delete "very".

On page 3, line 26, change "An advantageous further refinement" to --An embodiment--.

On page 4, delete lines 10-11.

On page 4, before line 13, insert --Brief Description of the Drawings--.

On page 4, line 13, change "in the following, on the basis of" to --below with reference to the drawings, in which:--.

On page 4, delete line 14.

On page 4, line 16, after "Figure 1" insert --shows--.

On page 4, line 18, after "Figure 2a" insert --shows--.

On page 4, line 20, after "Figure 2b" insert --shows--.

On page 4, line 22, after "Figure 2c" insert --shows graphs depicting--.

On page 4, line 24, after "Figure 3" insert --shows a schematic diagram of--.

On page 4, line 26, change "a further" to --shows a schematic diagram of another--.

On page 4, line 29, change "three diagrams" to --show three graphs--.

On page 5, line 1, change "a further" to --shows a schematic diagram of another--.

On page 5, line 3, change "a diagram" to --shows a graph--.

On page 5, line 5, change "a further" to --shows a schematic diagram of another--.

On page 5, line 7, change "a further" to --shows a schematic diagram of another--.

On page 5, line 9, change "a further" to --shows a schematic diagram of another--.

On page 5, line 11, change "a further" to --shows a schematic diagram of another--.

On page 5, line 13, change "a further" to --shows a schematic diagram of another--.

On page 5, line 15, change "a further" to --shows a schematic diagram of another--.

On page 5, line 17, change "an embodiment" to --shows a schematic diagram of an embodiment of a component array--.

On page 5, line 19, change "a diagram" to --shows a schematic diagram-- and change "the method; and" to --a method for wavelength tuning in an optoelectronic component array;--.

On page 5, line 21, change "13" to --13a shows a schematic diagram of--, after "embodiment" insert --of a component array-- and change "source." to --source; and Figure 13b shows a circuit diagram representing the component array of Figure 13a.-- .

On page 5, before line 23 insert --<u>Detailed Description</u>--.

On page 6, line 12, change "are preferably" to --may be--.

On page 6, line 25, delete "very".

On page 9, line 12, change "must be" to --is--.

On page 9, line 20, change "must be" to --are--.

On page 9, line 26, after "embodiment" insert --of the present invention--.

On page 11, line 25, change "represent" to --each represents--, delete "remarks" and before "component" insert --respective--.

On page 11, line 28, change "preferably" to --which may be--.

On page 11, line 29, change "construction of the arrangement itself" to --arrangement--.

On page 12, line 22, change "bonds" to --bond connections--.

On page 12, line 28, change "bond" to --bond connection--.

On page 13, line 9, after "embodiment" insert --of the present invention-- and delete "essentially".

On page 13, replace line 23 with --Binary coding of the resistance values may be used, making it--.

On page 13, line 29, change "must be" to --are--.

On page 14, line 13, change "step size" to --increment, or step size,--.

On page 15, line 21, after "array" insert --of the present invention--.

On page 15, line 25, change "bonds" to --bond connections--.

On page 16, line 7, after "embodiment" insert --of the present invention--.

On page 16, line 12, change "preferably" to --such as--.

On page 16, line 19, after "embodiment" insert --of the present invention--.

On page 16, line 22, change "bonds" to --bond connections--.

On page 16, line 25 after "embodiment" insert --of the present invention--.

On page 16, line 30, after "embodiment" insert --of the present invention--.

On page 17, line 4, change "bonds" to --bond connections--.

On page 17, line 6, after "embodiment" insert --of the present invention--.

On page 17, line 20, after "embodiment" insert --of the present invention--.

On page 18, line 4, after "embodiments" insert --of the present invention--.

Delete all lines on page 19.

On page 20, line 1, change "Patent Claims" to --WHAT IS CLAIMED IS:--.

IN THE CLAIMS

Please cancel without prejudice claims 1-17 and add new claims 18-36 as follows:

--18. (new) A method for the wavelength tuning of an optoelectronic component array, the optoelectronic component array including at least two optoelectronic components, the method comprising:

comparing a respective measured wavelength with a respective desired characteristic wavelength so as to determine a respective wavelength deviation for each of the at least two optoelectronic components; and

selectively changing a respective resistance value of a respective resistor arrangement connected between each of the at least two optoelectronic components and a respective resistance heater associated with each of the at least two optoelectronic components so as to achieve a respective thermal change of the respective resistance heater for setting the respective desired characteristic wavelength of each of the at least two optoelectronic components.

19. (new) The method as recited in claim 18 wherein the selectively changing is performed using circuitry.

20. (new) The method as recited in claim 18 wherein the selectively changing is performed by changing a respective material of the respective resistor arrangement.

21. (new) The method as recited in claim 20 wherein the changing a respective material of the respective resistor arrangement if performed by removing or applying the respective material.

22. (new) The method as recited in claim 18 wherein the selectively changing is performed using laser ablation.

23. (new) The method as recited in claim 18 wherein the selectively changing is performed using heat treatment.

24. (new) The method as recited in claim 18 wherein the selectively changing is performed using at least one of a chemical and an electrochemical treatment.

25. (new) The method as recited in claim 18 wherein the selectively changing is performed using at least one of particle implantation, electromagnetic radiation and particle radiation.

26. (new) The method as recited in claim 18 wherein the selectively changing is performed using an electrical signal.

27. (new) The method as recited in claim 18 wherein the method is performed at regular intervals.

28. (new) A device for the wavelength tuning of an optoelectronic component array having at least two optoelectronic components, the device comprising:

a respective at least one resistance heater associated with each of the at least two optoelectronic components for setting a respective characteristic wavelength of the respective optoelectronic component;

a common voltage or current source; and

a respective resistor arrangement connected between each respective at least one resistance heater and the common voltage or current source, a respective total resistance of each respective resistor arrangement being variable.

29. (new) The device as recited in claim 28 wherein each respective resistor arrangement includes respective individual resistors disposed in a respective resistor array.

30. (new) The device as recited in claim 28 wherein respective resistors of each respective resistor arrangement are connected between a respective contact fields disposed in rows, the respective resistors being arranged in a fixed order with regard to their respective resistance values, a respective total resistance of each respective resistor arrangement being achieved using the respective contact fields.

31. (new) The device as recited in claim 30 wherein the respective total resistance of each respective resistor arrangement is achieved using bond connections.

32. (new) The device as recited in claim 29 wherein respective resistors of each respective resistor arrangement are connected between respective contact fields disposed in respective rows, a respective resistors being arranged in a fixed order with regard to their respective resistance values, the respective total resistance of each respective resistor arrangement being achieved using the respective contact fields, and wherein the respective contact fields include a plurality of bond pads for attachment of electric leads.

33. (new) The device as recited in claim 28 wherein respective resistors of the respective resistor arrangements include at least one of metal, non-metal, semiconductor material, liquid, gel, ceramic, oxide, metal-matrix compound, liquid crystals and polymers.

34. (new) The device as recited in claim 28 wherein the at least two optoelectronic components are disposed on a first body and at least a portion of the respective resistor arrangements are disposed on at least one second body.

35. (new) The device as recited in claim 34 wherein the first body includes semiconductor materials and the at least one second body includes an insulator.

36. (new) The device as recited in claim 28 wherein each of the at least two optoelectronic components includes at least one of a solid-state laser, an optical amplifier, a filter, a wavelength multiplexer and a waveguide.--.

IN THE ABSTRACT

Line 1, change "The invention relates to a cost-reductive" to --A--.

Line 2, change "comprising" to --including--.

Line 3, change "According to the invention, the" to --The--.

Line 4, change "by means of" to --using--, before "resistance" insert --respective-- and delete "(RM)".

Line 5, delete "(U_0/I)", before "heating" insert --respective-- and delete "(H)".

Line 6, change "pertaining to said components" to --associated with each optoelectronic component--.

Line 7, before "resistance" insert --respective-- and delete "The invention".

Line 8, change "can be used to tune the" to --The--.

Line 9, after "waveguides" insert -- may be tuned--.

REMARKS

This Preliminary Amendment cancels original claims 1-17 in the underlying International Application No. PCT/EP98/06911 and adds new claims 18-36. The new claims do not add new matter to the application but do conform the claims to U.S. Patent and Trademark Office rules.

The amendments to the specification, abstract and drawings are to conform the specification, abstract and drawings to U.S. Patent and Trademark Office rules. It is respectfully submitted that the amendments to the specification, abstract and drawings do not introduce new matter into the application.

The underlying PCT application includes an International Search Report, a copy of which is included herewith, and an International Preliminary Examination Report, a translation of which is submitted herewith.

Conclusion

Consideration of the present application as amended is hereby respectfully requested.

Respectfully Submitted,

Kenyon & Kenyon

Dated: 6/1/00

By: [signature]

Richard L. Mayer
(Reg. No. 22,490)

One Broadway
New York, NY 10004

Tel. (212) 425-7200
Fax. (212) 425-5288

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[2345/117]

METHOD AND ARRANGEMENT FOR WAVELENGTH TUNING IN AN OPTOELECTRONIC COMPONENT ARRAY

Background of the Invention

The present invention relates to a method for tuning the wavelengths of optoelectronic components in an optoelectronic component array.

The present invention relates to an optoelectronic component arrangement having at least two optoelectronic components. Each individual optoelectronic component of the component array has an associated resistance heater for setting the characteristic wavelength of the optoelectronic component.

Optical transmission systems are being increasingly used for the transmission of data and for the transmission of television and radio channels. Generally, such optical transmission systems include a light-conducting waveguide, and a solid-state laser as a light generator and a light detector. The solid-state laser emits light of a defined, characteristic wavelength. This characteristic wavelength is essentially dependent on the material used, but it can be set within a defined wavelength range, for example, by the action of heat. To increase the volume of data that can be transmitted through a waveguide, it is possible to employ a plurality of solid-state lasers associated with a waveguide, the solid-state lasers operating with different wavelengths. In this connection, however, precise adherence to the wavelengths is needed, making it possible for the data to be differentiated unambiguously at the end of the transmission.

Since, for reasons inherent to the manufacturing process, the characteristic wavelengths of solid-state lasers vary within a tolerance range, it is necessary for the

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solid-state lasers to be tuned before they are used for the transmission of data. So-called resistance heaters, for example, are used for this purpose, the resistance heaters changing the characteristic wavelength of a solid-state laser through the action of heat. Generally, tuning is accomplished by adjusting the voltage applied to the resistance heater, a separate voltage source being associated with each resistance heater and, thus, with each optoelectronic component of the component arrangement.

However, this entails the disadvantage that a very complex design is required. Furthermore, later tuning of the arrangement is not easily possible.

The object of the present invention, therefore, is to indicate a method for tuning optoelectronic components, the method being simple and able to be implemented at minimal cost. Furthermore, the device required for the implementation of the method is to be indicated.

The object of the present invention is achieved by a method that is likewise based on the principle of thermally changing the resistance heaters of the optoelectronic components of the optoelectronic component array in question.

The object of the present invention is achieved by a method having the features of Claim 1. The component array is implemented by a design approach having the features of Claim 9. The method is based on the fact that, in the first method step, the wavelength is measured for each optoelectronic component of the optoelectronic component array. On the basis of a comparison of the measured wavelength with the desired characteristic wavelength, the deviation from the desired characteristic wavelength is determined for each optoelectronic component of the optoelectronic component array. Next, according to the present invention, a resistor arrangement associated with the respective optoelectronic component is modified as a function of the ascertained wavelength deviation. By way of its total resistance, the resistor arrangement, which is connected upstream of the heater of the optoelectronic

component, influences the heating power of the heater of the optoelectronic component. The total resistance of the resistor arrangement is set such that, by way of the heating power, the desired characteristic wavelength of the optoelectronic component in question is obtained. This procedure is carried out on an individual basis for each optoelectronic component of the optoelectronic component array. The method according to the present invention permits the very simple setting of the optoelectronic components of a component array, such as a row of solid-state lasers. In particular, the method can be performed fully automatically, which is a significant advantage when optoelectronic components are used on a large scale.

The present invention provides for its component array to include resistor arrangements RM, in addition to a common voltage source U_0. Each optoelectronic component of the component array is associated with a separate resistor arrangement RM. The resistor arrangement RM is disposed between common voltage source U_o and resistance heater H; i.e., a separate resistor arrangement RM is connected upstream from each resistance heater H. Each resistor arrangement RM is composed of a network of resistors R. Consequently, the heating power for each optoelectronic component of the optoelectronic component array can be set very easily by making corresponding changes to the resistor network. Since all resistor arrangements RM are supplied by a single voltage source U_o, the need is eliminated for a substantial amount of circuitry, resulting in cost savings. A further advantage is that the characteristic wavelengths of the optoelectronic components can also be subsequently tuned in a very simple manner by changing the total resistance and, thus, the heating power.

An advantageous further refinement of the present invention provides for configuring resistor arrangement RM in the form of a resistor array, which includes a plurality of resistor elements arranged systematically according to resistance values. Preferably, resistor arrangement RM includes one or more rows of contact fields K, the resistors of resistor arrangement RM being disposed between individual contact fields K. The

total resistance of resistor arrangement RM and, thus, the heating power of the heater of the optoelectronic component can be altered by switching or bypassing contact fields K. Since contact fields K and the resistors are arranged according to logical aspects, the heating power can be simply set by the manner in which contact fields K are interconnected, it being possible to determine the specifically required connections from the systematic nature of the matrix. At the same time, the method according to the present invention also makes it possible to adapt the heating power, at any time, as needed.

Further advantageous embodiments of the arrangement according to the present invention are revealed in the dependent claims.

The present invention is explained in greater detail in the following, on the basis of embodiments, reference being made to the drawing, illustrating in its:

Figure 1 a block diagram of an optoelectronic component array;

Figure 2a a schematic representation of a resistor apparatus;

Figure 2b a circuit diagram of the resistor apparatus;

Figure 2c how the heating powers of different channels influence each other;

Figure 3 a first embodiment of a component array;

Figure 4a a further embodiment of a component array;

Figures 4b to 4d three diagrams for determining the heating power;

Figure 5a a further embodiment of a component array;

Figure 5b a diagram for calculating the heating power;

Figure 6 a further embodiment of a component array;

Figure 7 a further embodiment of a component array;

Figure 8 a further embodiment of a component array;

Figure 9 a further embodiment of a component array;

Figure 10 a further embodiment of a component array;

Figure 11 a further embodiment of a component array;

Figure 12a an embodiment having the resistor array on the row of components;

Figure 12b a diagram illustrating the method; and

Figure 13 an embodiment including a current source.

Figure 1 shows a component array 1 including a number of solid-state lasers L1 to Ln. The basic construction of such a row of solid-state lasers is generally known, so that it is not precisely described here. To simultaneously transmit data in an optical data transmission system, solid-state lasers L1-Ln operate with different wavelengths or frequencies. For reasons inherent to the manufacturing process, solid-state lasers L1-Ln do not always emit radiation of the desired wavelength. For that reason, prior to and/or during initial operation, they are tuned to the desired wavelength by changing the characteristic wavelength, the thermal effect being exploited in the present case.

By individually subjecting solid-state lasers L1-Ln to a suitable, defined temperature, it is possible to vary the respective wavelength within a defined range.

For this purpose, each solid-state laser L1 to Ln is associated with at least one resistance heater H1 to Hn. Each of resistance heaters H1 to Hn is made up of a current conductor, which has a suitably high resistance and generates heat when a voltage is applied, and produces a temperature field in the respective solid-state laser L1-Ln. To produce the desired temperature field, it is necessary in many cases for the heating power to first be adjusted. To this end, each resistance heater H1-Hn is connected, according to the present invention, to a separate resistor array RM1-RMn. All resistor arrangements RM1-RMn are connected to a common voltage source U_o and are supplied by it. Resistor arrangements RMl-RMn are preferably in the form of resistor arrays composed of individual resistors. By selectively manipulating the individual resistors, one selectively changes the total resistance of the resistor arrangement, configured as a resistor array. Changing the total resistance of the individual resistor arrangements RM1-RMn effects a change in the current flowing through resistance heaters H1-Hn and, therefore, in the heating power of individual resistance heaters H1-Hn. The wavelength is altered on an individual basis by varying the heating power of individual resistance heaters H1-Hn until the desired characteristic wavelength is set for each individual solid-state laser L1-Ln. The resistors of resistor arrangements RM1-RMn are set to defined resistance values electrically, optically and/or by electromagnetic waves. Resistor arrangements RM1-RMn can, on the one hand, be disposed on a substrate/insulator carrying solid-state lasers L1-Ln. Resistor arrangements RM1-RMn can also be disposed separately from solid-state lasers L1-Ln, for example at a later, very easily accessible location of the entire data transmission unit.

As already mentioned, characteristic wavelength λ_q of each individual optoelectronic component, such as of solid-state lasers L1-Ln, can be individually set by varying the temperature of each individual solid-state laser L1-Ln and, therefore, by way of

heating power P_q, or heating current I_q, through resistance heaters H1-Hn. The basis for individually setting the heating current for each channel q, with q $\in$ [1-n] is provided by the matrix-like arrangement of resistor arrangements RM1-RMn. Figure 2a shows such a resistor arrangement for channel q. The resistor arrangement includes contact fields $K_{q,i,j}$ having coordinates (i,j), where i $\in$ [1, r] and j $\in$ [1, s], q indicate the component number (channel) and r and s, respectively, denote the size of the matrix-like resistor arrangement in the y and x directions. Plotted indices j and i denote the column and row numbers. This matrix-like arrangement of contact fields is also referred to in the following as a contact matrix. The contact fields are connected by ohmic resistors $R_{q,i,j \rightarrow q,k,l}$, where $R_{q,i,j \rightarrow q,k,l}$ denotes a resistance between the contact fields $K_{q,i,j}$ and $K_{q,k,l}$. The resistance values of the ohmic resistors include values $R_{q,i,j \rightarrow q,k,l} = 0$ ohm (short circuit) to $R_{q,i,j \rightarrow q,k,l} \rightarrow \infty$ (no electrically conducting connection or insulator). Contact fields $K_{q,t,u}$ and $K_{q,v,w}$, where (t,u) $\neq$ (v,w), are connected to an electrical voltage source U_o which generates a potential difference U(t) of any desired time characteristic, between the contact fields. The electrical connections of voltage source U_0 to contact fields $K_{q,t,u}$ and $K_{q,v,w}$ are identified in the following as LQ. An electrical connection LQ is composed of a number $f \geq 1$ of mathematically multiply connected and electrically interconnected, electrically conductive regions. These regions contain a number $g \geq 0$ of electrically conductive regions of resistance heater H_q of a channel q and a number $h \geq 0$ of electrically conductive regions of the matrix-like arrangement of contact fields. Contact fields $K_{q,a,b}$ and $K_{q,k,l}$, where (a,b)$\neq$(c,d), are connected by an electrically conducting connection to resistance heater H_q, in such a way that the potential difference between points $K_{q,a,b}$ and $K_{q,c,d}$ induces electric current to flow through resistance heater H_q, if resistance value R_q of resistance heater H_q is finite.

The arrangement, including voltage source U_0, electrical connections LQ, the matrix-like arrangement of contact fields, ohmic resistors $R_{q,i,j \rightarrow q,k,l}$ between contact fields $K_{q,i,j}$ and $K_{q,k,l}$, is manipulated or tuned according to the present invention in such a way that a heating power P_q automatically adjusts itself at electrical resistance heater H_q,

giving rise to a temperature change ΔT_q at solid-state laser L_q due to the thermal coupling of resistance heater H_q to solid-state laser L_q. This temperature change causes a wavelength shift $\Delta\lambda_q$ of the characteristic wavelength of channel q. Wavelength λ_q of channel q is individually set in accordance with the following method:

At the beginning of the process, a heating power $P_q \geq 0$ is set, the heating power resulting in a wavelength λ_q. The aim is to set the heating power, such that the wavelength is $\lambda_{q,s.}$

The resistance heater's heating power is varied within a range in which the associated change in wavelength covers the range of desired wavelength $\lambda_{q,s}$. This measurement yields a functional relationship $\lambda_q(P_q)$. Accordingly, it is possible, from the relationship, to determine heating power P_q for a wavelength $\lambda_{q,s}$. The desired heating power P_q can be set by changing resistor arrangement RMq. Heating power P_q can also be varied by adjusting the voltage at voltage source U_0, it being the case, however, that the heating powers of the other optoelectronic components are also altered accordingly. The maximum amount of the power variation $\Delta P_q P_q = P_{q,max}$ -- $P_{q,min}$ of a channel q is defined by the magnitude of the voltage applied to contact fields $K_{q,v,w}$ and $K_{q,v,w}$, the dimensioning and arrangement of resistors $R_{q,i,j \rightarrow q,k,l}$, and by short circuits between the contact fields, as well as by dimensionally sizing heating resistor P_q of resistance heater H_q. This power variation ΔP_q results in a maximum wavelength variation $\Delta\lambda_{q,max}$.

A further possibility for setting the characteristic wavelength provides for setting heating power P_q to a defined value $P \geq 0$ and for measuring the associated wavelength. Heating power P_q is then changed on the basis of stored empirical values for the functional relationship $\lambda_q(P_q)$.

It is also conceivable to successively set heating power P_q to two values and, each

time, to measure the associated wavelength. The characteristic of functional relationship $\lambda_q(P_q)$ is subsequently calculated by interpolation and/or extrapolation of the previously determined wavelengths, and heating power P_q is changed accordingly.

It is equally conceivable to vary heating power P_q at intervals, in defined steps ΔP, and to measure the corresponding wavelength to produce functional relationship λ_q (P_q), and to vary heating power P_q on the basis of the determined relationship.

It is, of course, also possible to continuously vary heating power P_q until the desired characteristic wavelength is obtained.

When adjusting heating power P_q, the following requirement must be met for the resistance values of connections LQ between voltage source U_O and the matrix-like arrangement of contact fields $K_{q,i,j}$-$K_{q,k,1}$, as well as the internal resistance of voltage source U_O: if, given a component arrangement of n channels having n resistance heaters and n arrangements of contact fields, a number of n-1 resistance heaters H has a heating power $P_{e,min}$, and any resistance heater H_s has heating power P_s, where $P_{s,min}<P_s<P_{s,max}$ and $s \neq e$, then electrical connections LQ of voltage source U_0 having the contact fields of individual channels q, as well as the internal resistance of voltage source U_0 must be dimensionally designed such that, in response to a variation in the heating powers of n-1 channels by ΔP_e, i.e., from $P_{e,min}$ to $P_{e,max}$, the heating power of resistance heater H_s varies by a value $\Delta P_{s,error}<\varepsilon_s \bullet \Delta P_s$, with a value $0<\varepsilon_s<1$ which is freely selectable, but which should be as small as possible, to minimize the cross-influencing of the channels.

Figure 2b shows the circuit diagram of an embodiment including three resistance heaters. In this simple case, the matrix-like arrangement of contact fields is such that they can be combined to form total resistances (referred to in the following as series resistors P_{V1}-R_{V3}) which can be connected in series with heating resistor R_{H1}-R_{H3}. Electrical connections LQ of voltage source U_0 to the contact fields leading to total

resistors R_{V1}-R_{V3} and heating resistors R_{H1}-R_{H3} feature a line resistance R_{L1}-R_{L3}. The internal resistance of voltage source U_0 is contained in resistor R_{L1}.

The resistance values of series resistors R_{V1}-R_{V3} and heating resistors R_{H1}-R_{H3} are dimensioned according to required heating powers P_1 - P_3 or wavelength shifts and the magnitude of available voltage U_0. Line resistances R_{L1}-R_{L3} must meet the above requirement. The powers of heating resistors R_{H1}-R_{H3} result from:

$p_q = I_q^2 R_{Hq}$ where q = 1,2,3 and R_{Hq}, = resistance of the q-th heater H_q

and from the currents

$$I_1 = \frac{U_o}{R_{tot}}\left(1 - \frac{R_{L1}}{R_{tot}}\right)$$

$$I_2 = \frac{U_O}{R_\beta}\left[1 - \frac{R_{L1}}{R_{tot}} - \frac{R_{L2}}{R_{tot}} + \frac{R_{L2}}{R_\gamma}\left(1 - \frac{R_{L1}}{R_{tot}}\right)\right]$$

$$I_3 = \frac{U_O}{R_\alpha + R_{L3}}\left[1 - \frac{R_{L1}}{R_{tot}} - \frac{R_{L2}}{R_{tot}} + \frac{R_{L2}}{R_\gamma}\left(1 - \frac{R_{L1}}{R_{tot}}\right)\right]$$

and

$R_\alpha = R_{L3} + R_{V3} + R_{H3}$

$R_\beta = R_{V2} + R_{H2}$

$R_\gamma = R_{V1} + R_{H1}$

R_{tot} = total resistance

Figure 2c shows the aforementioned requirement for channel 1. Heating power P_1 of channel 1 has any value within ΔP_1. The remaining channels 2 and 3, respectively, have heating powers of $P_{2,min}$ and P_{3min}. If the heating powers of channels 2 and 3 are raised to $P_{2,max}$ and $P3_{,max}$, the deviation from P_1, must be less than $\varepsilon_1 \bullet \Delta P_1$.

The following briefly shows the calculation of the resistances R_{L1} to R_{L3}:

$$\frac{\Delta P_{1,error}}{\Delta P_1} = \frac{P_{,1}^{(min)}(R_{V1}, R_{L1}, R_{L2}, R_{L3}) - P_1^{(max)}(R_{V1}, R_{L1}, R_{L2}, R_{L3})}{\Delta P_1} < \varepsilon_1$$
$$\text{for any } R_{V1}$$

$$\frac{\Delta P_{2,error}}{\Delta P_2} = \frac{P_2^{(min)}(R_{V2}, R_{L1}, R_{L2}, R_{L3}) - P_2^{(max)}(R_{V2}, R_{L1}, R_{L2}, R_{L3})}{\Delta P_2} < \varepsilon_2$$
$$\text{for any } R_{V2}$$

$$\frac{\Delta P_{3,error}}{\Delta P_3} = \frac{P_2^{(min)}(R_{V3}, R_{L1}, R_{L2}, R_{L3}) - P_3^{(max)}(R_{V3}, R_{L1}, R_{L2}, R_{L3})}{\Delta P_3} < \varepsilon_2$$
$$\text{for any } R_{V3}$$

where

$P_q^{(min)}$: heating power of channel q, the remaining channels having a heating power $P = P_{s,min}$;

$P_q^{(max)}$: heating power of channel q, the remaining channels having a heating power $P = P_{s,max}$.

From the above three equations, it is possible to calculate the maximum values of line resistances R_{L1}, R_{L2}, R_{L3}.

Figures 3 to 11 represent the realization of the above remarks in a component arrangement, as described in detail in the following.

Figure 3 shows a component array 1 including three components, preferably solid-state lasers L1, L2 and L3. The construction of the arrangement itself is divided into

two parts, the three solid-state lasers L1 to L3 being disposed in the first part. Furthermore, the first part of the arrangement includes resistance heaters H1 to H6, as well as a part of the contact fields of contact matrix (K1-K4; K13-K16; K25- K28), H1, H2 and K1-K4 belonging to channel 1, H3, H4 and K13-K16 being associated with channel 2, and HS, H6 as well as K25-K28 being assigned to channel 3. The resistance heaters H1-H6 are arranged such that they are in thermal contact with solid-state lasers Ll to L3 associated with them.

The second part of the arrangement includes an insulator on which is situated - for each channel, i.e., for each solid-state laser Ll to L3 - the second part of the contact fields of contact matrix (KS to K12 for channel 1, K17 through K24 for channel 2, and K29 through K36 for channel 3). In the present case, the contact matrix is a one-dimensional matrix having twelve fields. Leads LQ to voltage source U_0 are at the upper edge of the row of lasers and at the lower edge of the row of contacts. The leads include the following regions: AO, B, A1, K25, B, K26, A2, K13, B, K14, A3, K1, B, K2 as well as, on the insulators, A4, K36, A5, K24, A6, K12, B being bond connections.

Consequently, the leads contain regions of the contact matrices.

Situated next to the contact matrices on the contact arrangement are further contact fields K_{L1} to K_{L3}, which are connected by electrically conducting bonds B to the contacts of the rows of lasers L1-L3. Contact fields K5 to K12 of channel 1, K17 through K24 of channel 2, and K29 through K36 of channel 3 of the contact matrices are provided with an electrically conducting connection to resistors R1-R7; R8-R14 and R15-R21 by spatially distributed resistor arrangements. In Figure 3 they are represented as black loops. Contact field K4 is electrically connected to contact field KS by a bond. The same applies to contact fields K16 and K17, as well as K28 and K29. The supply voltage of the resistance heater is applied between regions A4 and A0, this being indicated by an arrow.

The resistance heaters H1-H6 are set to a defined heating power P_q by changing the resistances between the contacts of the contact matrix, it also being possible to implement this by adding electrical connections or by changing the loop-shaped resistor arrangements.

The extent to which the heating power required during the tuning process varies is adjusted by a variable voltage at voltage source U_0.

The embodiment shown in Figure 4a is essentially similar to the example in Figure 3. It differs by the arrangement of the contact matrix, which, in this case, is made up of 11 contact fields (K1 through K11 for channel 1, K12 through K22 for channel 2, and K23 through K33 for channel 3). Located between contact fields K6 through K10 and contact fields K11, K17 - K21 and K22, as well as K28 - K32 and K33, are ohmic resistors having the values:

$$R1 = R6 = R11 = 1/1 \cdot R,$$
$$R2 = R7 = R12 = 1/2 \cdot R,$$
$$R3 = R8 = R13 = 1/4 \cdot R,$$
$$R4 = R9 = R14 = 1/8 \cdot R,$$
$$R5 = R10 = R15 = 1/16 \cdot R,$$

resistance R being defined by the maximum and minimum settable resistance. It is a question here, therefore, of binary coding of the resistance values, making it possible to span a resistance range from R to $R/2^i$, i being the number of resistors per channel. Thus, given five resistors, thirty-one different resistance values can be set. For example, for channel 1, electrically conducting connections are established from contact field K5 to contact fields K6 to K10. If, for example, resistance value $1/6 \cdot R$ is to be set for channel 1, then, as implemented in Figure 4a at component L1, resistor $R2 = ½ \cdot R$ and resistor $R3 = ¼ \cdot R$ must be connected in parallel. A resistance value of $1/25 \cdot R$ is set at component L2, and a resistance value of $1/10 \cdot R$ is set at

component L3.

For the case that U_0 = 2.5 V,R = 480 ohm and R_H = 20 ohm, Figure 4b shows the heating power characteristic on the left-hand ordinate axis as a function of the set index. The resistance value results as $R_{res} = R/_{Index}$. The power is calculated according to:

$$P(R) = \frac{U_0^2}{\left(R_{res} + R_H\right)} R_H$$

R_{res} being the resultant resistance.

The relative step size is plotted on the right-hand ordinate axis in Figure 4b. A relative increment of one corresponds to the increment of the linear relationship between the heating power and the set index. Good agreement with the linear characteristic can be obtained by dimensioning of heating resistors H1 - H6, voltage U_0 and resistance R.

It may be advantageous, for high heating powers, for example, to adjust heating power P_q in disproportionately small (large) increments, as is done in Figure 4c (Figure 4d), by selecting the supply voltage and the value for R, accordingly. For the case of large increments at high heating powers (Figure 4d), the heating voltage is 20 V and the value of R = 8kohm. In the case of small increments at high heating powers, the heating voltage is 1.5 V and the value of R = 40 ohm.

Figure 5a shows a variation of Figure 3. The loop-shaped resistor distributions in Figure 3 are implemented as a straight resistor arrangement RI in Figure 5a. For channel 1, for example, contact fields K5 to K12 pick off resistance RI at various points. Also, in this example, the resultant resistance values can be coded in a binary manner, provided that the resistances between two adjacent contact fields including

K5 to K12 for channel 1, K17 to K24 for channel 2, and K29 to K36 for channel 3 are dimensioned, as shown by way of example for channel 1.

R1 = Resistance between K5 and K6 $= R$
R2 = Resistance between K6 and K7 $= R \cdot 2$
R3 = Resistance between K7 and K8 $= R \cdot 4$
R4 = Resistance between K8 and K9 $= R \cdot 8$
RS = Resistance between K9 and K10 $= R \cdot 16$
R6 = Resistance between K10 and K11 $= R \cdot 32$
R7 = Resistance between K11 and K12 $= R \cdot 64$

For example, there is a resultant resistance of Rl + R3 + R4 + R6 for solid-state laser L1. The same applies to the remaining channels.

Figure 5b shows the variation in power for the case of binary coding. With reference to channel 2, it is shown how it is possible to achieve further total resistance values with any combination of overlapping connections between the contact fields, for example through connections between contact fields K17 and K19, as well as K18 and K20.

Figure 6 shows a further embodiment of a component array, six resistors being available per channel (R1 through R6 for channel 1; R7 through R12 for channel 2, and R13 through R18 for channel 3) for setting heating power P_q. By way of contact fields K5 to K18 (for channel 1 for example), the resistors can be interconnected, as needed, via bonds B.

The contact matrix shown in Figure 7 includes six contact fields per channel. Fields K5 and K6 (for channel 1) are electroconductively interconnected using a tunable resistor arrangement. The resistor arrangement is composed of two regions S1 and S2, which, in turn, include a region of electrically conducting material X (cross-

hatching) and an insulating region having an insulator Y (white). The total resistance between the contact fields is reduced by applying a highly conductive material I (black), solder for example, to regions S1 and S2. Region S2 is used for the coarse setting of the heating power, and region S1 is used for the fine tuning of the heating power.

The embodiment shown in Figure 8 differs from that shown in Figure 7, in that tuning is accomplished by changing the resistance of randomly shaped regions, shown as differently marked areas and having different electrical conductivities. These resistors RI-RV are made of different resistance materials. The resistance values of resistors RI-RV can be set to the desired resistance value, for example, by selectively changing the material, preferably by removing or applying material.
Laser ablation, for example, can be used to remove or apply material. Furthermore, the resistance value of resistors RI-RV can be modified by heat treatment, chemical treatment or electrochemical treatment. Other ways to alter the resistance value include influencing it by particle implantation, electromagnetic radiation or particle radiation, or by an electrical signal.

The embodiment shown in Figure 9 differs from that shown in Figure 8 in that any kinds of electrically conductive connections are applied between the randomly shaped resistors, the resistors being made of different resistance materials. The connections may be, for example, bonds B. Tuning is accomplished by applying or removing bonds or, alternatively, using the method described in Figure 8.

In the embodiment shown in Figure 10, resistor arrangements RM for the three channels are formed by resistors R1 through R3. Tuning is carried out by applying electrically conductive connections, such as connections B, whose electrical conductivity is greater than resistor arrangement RM.

Figure 11 shows a further embodiment in which the contact matrix for channel 1

includes contact fields K1 to K12. Between contact fields K6 and K11 are disposed electrically conducting connections R1 to R6 which are shown as curved lines in the drawing. The total resistance of the contact matrix is tuned using additional electrical connections, constituted as bonds B.

Figure 12a depicts an embodiment in which the resistors of resistor arrangement RM are disposed on the row of components, with the result that resistor arrangement RM is tuned on the row of components.

At this point, the above-described method for tuning solid-state lasers L1 to Ln shall be briefly explained once again with reference to Figure 12b. Thus, first of all, a defined heating power $P \geq O$ is set individually for each solid-state laser L1 to Ln by resistor apparatus RM1 through RMn or, alternatively, by voltage source U_0. Next, the wavelength is measured for each solid-state laser L1 through Ln. On the basis of functional relationship $\lambda(P)$, the resistor arrangement associated with corresponding solid-state laser L1-Ln is tuned. Depending on the process selected, these steps are carried out a number of times until, finally, the desired characteristic wavelength is obtained for each solid-state laser L1-Ln.

It becomes clear from the aforementioned embodiment that there is a multiplicity of possibilities for individually setting the heating powers P_q of individual resistance heaters H1-Hn in simple manner using resistor arrangement RM1-RMn according to the present invention, without having to revert to a plurality of voltage sources U_0. In particular, individual resistors R1-Rn or RI-RV, etc., of resistor arrangements RM1-RMn can be changed at any time, even afterwards, following initial operation of the component array. Thus, it is conceivable, for example, to change the wavelength or heating power P_q using time and temperature measurements on the basis of empirical values, in order, for example, to compensate for aging effects.

In addition, the present invention can be applied not only to the described solid-state

lasers L1-Ln, but in general to optoelectronic components, such as optical amplifiers, filters, wavelength multiplexers or waveguides.

In the aforementioned embodiments, a voltage source U_0 is used in each case as the energy supply apparatus. Of course, it is also possible to use a current source I, as shown in Figure 13, resistor arrangement RM1-RMn and resistance heaters H1-Hn being in parallel to each other, and not in series.

List of reference symbols

L1-Ln	Solid-state lasers
U_0	Voltage source
I	Current source
H	Resistance heater
H1-Hn	Resistance heaters of solid-state lasers
Hq	Resistance heater of a channel q
Rq	Resistance of the resistance heater of a channel q
$R_{q,i,j}$-$R_{q,k,l}$	Resistors of resistance heaters
R_{v1}-R R_{v3}	Series resistors
R_{L1}-R_{L3}	Line resistors of Rq
LQ	Electrical connections of voltage source U_0 to the contact fields of individual channels q
P_q	Heating power of a channel q
RM	Resistor arrangement
RM1-RMn	Resistor arrangements of optoelectronic components
R1-Rn	Resistors of resistor arrangements
RI- RXVII	Resistors of resistor arrangement, of different resistance material
A1-An	Connections and conductive regions, which are not really resistors
B	Bonds
K1-Kn	Contact fields (bond pads)
K_{L1}-K_{L3}	Contact fields
$K_{q,i,j}$-$_{q,k,l}$	Contact fields
$K_{q,t,u}$-$_{q,v,w}$	Contact fields
x,y	Location coordinate
Distance	S1;S2

Patent Claims

1. A method for the wavelength tuning of an optoelectronic component array having at least two optoelectronic components, the characteristic wavelength being set for each optoelectronic component using the principle of the thermal setting of the characteristic wavelength using the respective resistance heater, the wavelength deviation being determined on the basis of a comparison of the measured wavelength with the desired characteristic wavelength, **characterized in that** the thermal change of the resistance heater (H) required for setting the characteristic wavelength of the optoelectronic component is accomplished by selectively changing the resistance value of a resistor arrangement (RM) connected upstream from resistance heater (H).

2. The method according to Claim 1, **characterized in that** the resistance value of the resistor arrangement (RM) is changed using circuitry-related measures.

3. The method according to Claim 1, **characterized in that** the resistance value of the resistor arrangement (RM) is modified by changing the material, preferably by removing or applying material.

4. The method according to Claim 1, **characterized in that** the resistance value of the resistor arrangement (RM) is varied using laser ablation.[1]

5. The method according to Claim 1, **characterized in that** the resistance value of the resistor arrangement (RM) is changed through heat treatment.

6. The method according to Claim 1, **characterized in that** the resistance value

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[1] Translator's note (revisor SFG): The German text has two Claims 3. This has been corrected in the translation, so that the claim numbering no longer corresponds to the original German text.

of the resistor arrangement (RM) is altered by chemical or electrochemical treatment.

7. The method according to Claim 1, **characterized in that** the resistance value of the resistor arrangement (RM) is varied by particle implantation, electromagnetic radiation, or particle radiation.

8. The method according to Claim 1, **characterized in that** the resistance value of the resistor arrangement (RM) is modified by an electrical signal.

9. The method according to any one of the preceding claims, **characterized in that** the method is carried out at regular intervals.

10. A device for the wavelength tuning of an optoelectronic component array having at least two optoelectronic components and at least one resistance heater (H) associated with each component for setting the characteristic wavelength of the optoelectronic component, **characterized in that** connected upstream of each resistance heater (H1-Hn) is a separate resistor arrangement (RM1-RMn), which is connected to the common voltage or current source (U_0/I), and which is variable in its total resistance.

11. The device according to Claim 9, **characterized in that** the resistor arrangements (RM1-RMn) include individual resistors disposed in an array of resistors.

12. The device according to Claims 9 and 10, **characterized in that** the resistors of the resistor arrangements (RM1-RMn) are connected between contact fields (K1-Kn) situated in rows, the resistors being arranged in a fixed order with regard to their resistance values in the respective row, the specific total

resistance of each individual resistor arrangement (RM1-RMn) being formed by way of the contact fields (K1-Kn), preferably by bonds (B).

13. The component array according to Claim 11, **characterized in that,** for the attachment of electric leads, the contact fields (K1-Kn) are preferably in the form of contact fields (K1-Kn) having bond pads.

14. The component array according to any one of the preceding claims, **characterized in that** the resistors of the resistor arrangements (RM1-RMn) are made alternatively of metal, non-metal, semiconductor material, liquid, gel, ceramic, oxide, metal-matrix compound, liquid crystals and polymers.

15. The component array according to any one of the preceding claims, **characterized in that** the optoelectronic components are disposed on a first body and at least parts of the resistor arrangements (RM1-RMn) are disposed on at least one further body.

16. The component array according to Claim 14, **characterized in that** the first body is preferably composed of semiconductor materials, the second body being an insulator.

17. The component array according to any one of the preceding claims, **characterized in that** the optoelectronic component is a solid-state laser, an optical amplifier, a filter, a wavelength multiplexer or a waveguide.

Abstract

The invention relates to a cost-reductive method and device for tuning the wavelength of an optoelectronic component arrangement comprising at least two optoelectronic components. According to the invention, the characteristic wavelength for each optoelectronic component is adjusted by means of a resistance device (RM) which is connected between a common voltage/power source (U_0/I) and a heating device (H) pertaining to said components. Heating capacity is modified by changing the overall resistance of the resistance device (RM) in order to adjust wavelength. The invention can be used to tune the wavelength of semiconductor lasers, filters, wavelength multiplexers and waveguides.

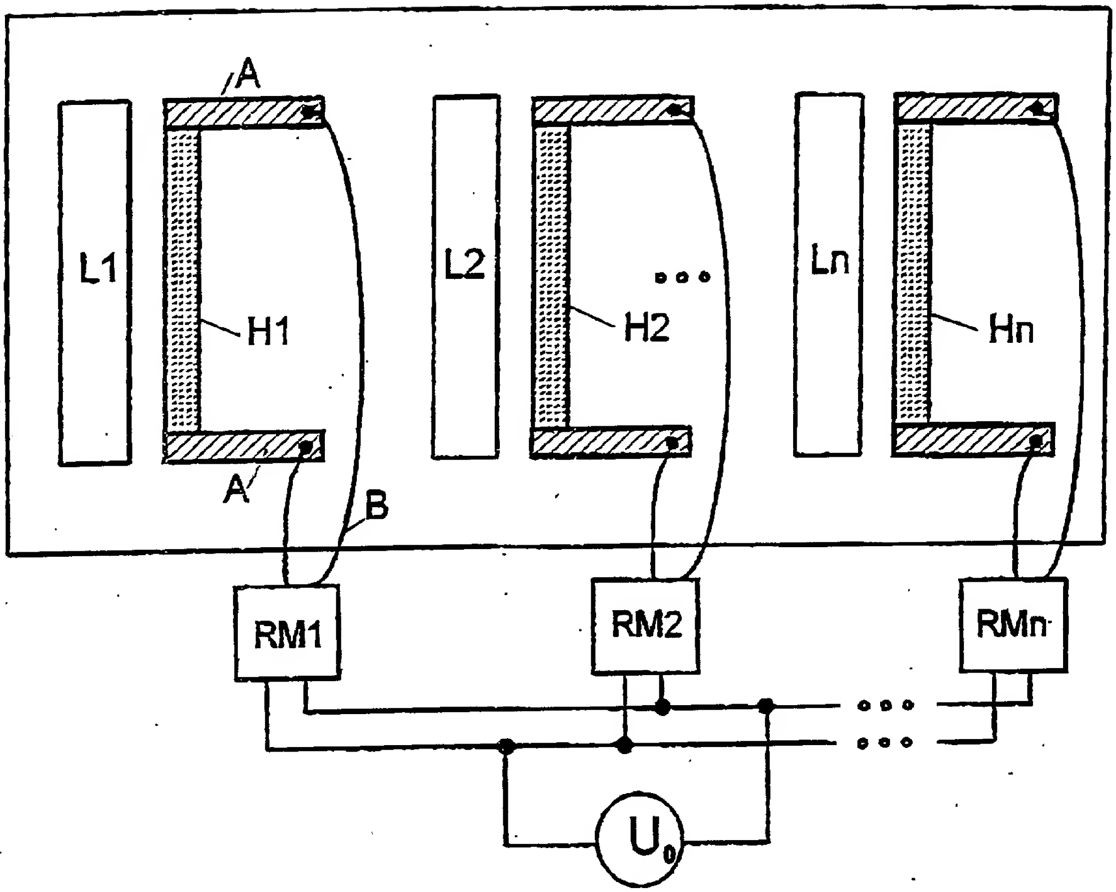

Fig. 1

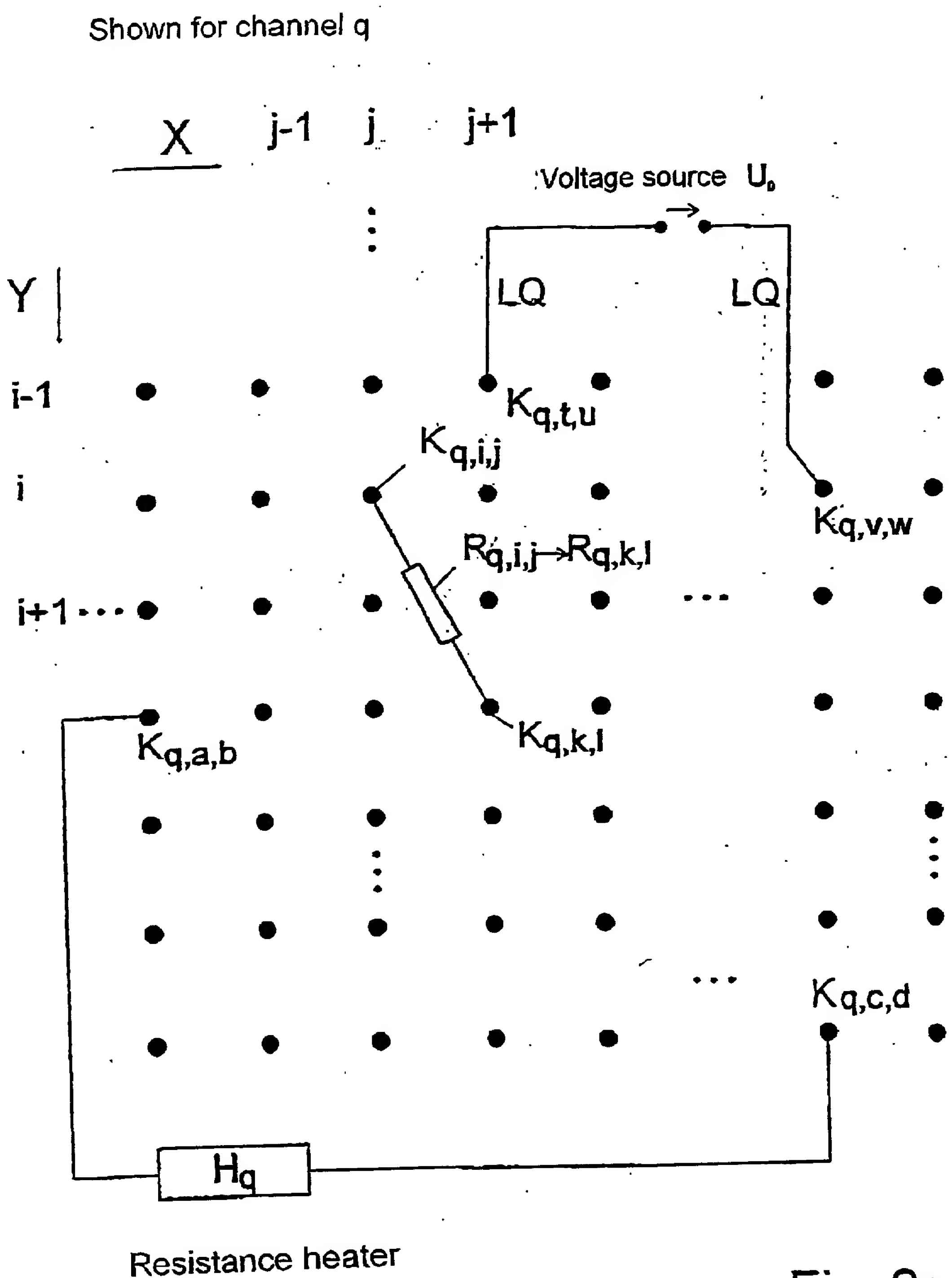
Shown for channel q
X
j-1
j
j+1
Voltage source U_0
Y
LQ
LQ
i-1
i
i+1
$K_{q,t,u}$
$K_{q,i,j}$
$K_{q,v,w}$
$R_{q,i,j} \rightarrow R_{q,k,l}$
$K_{q,k,l}$
$K_{q,a,b}$
$K_{q,c,d}$
H_q
Resistance heater

Fig. 2a

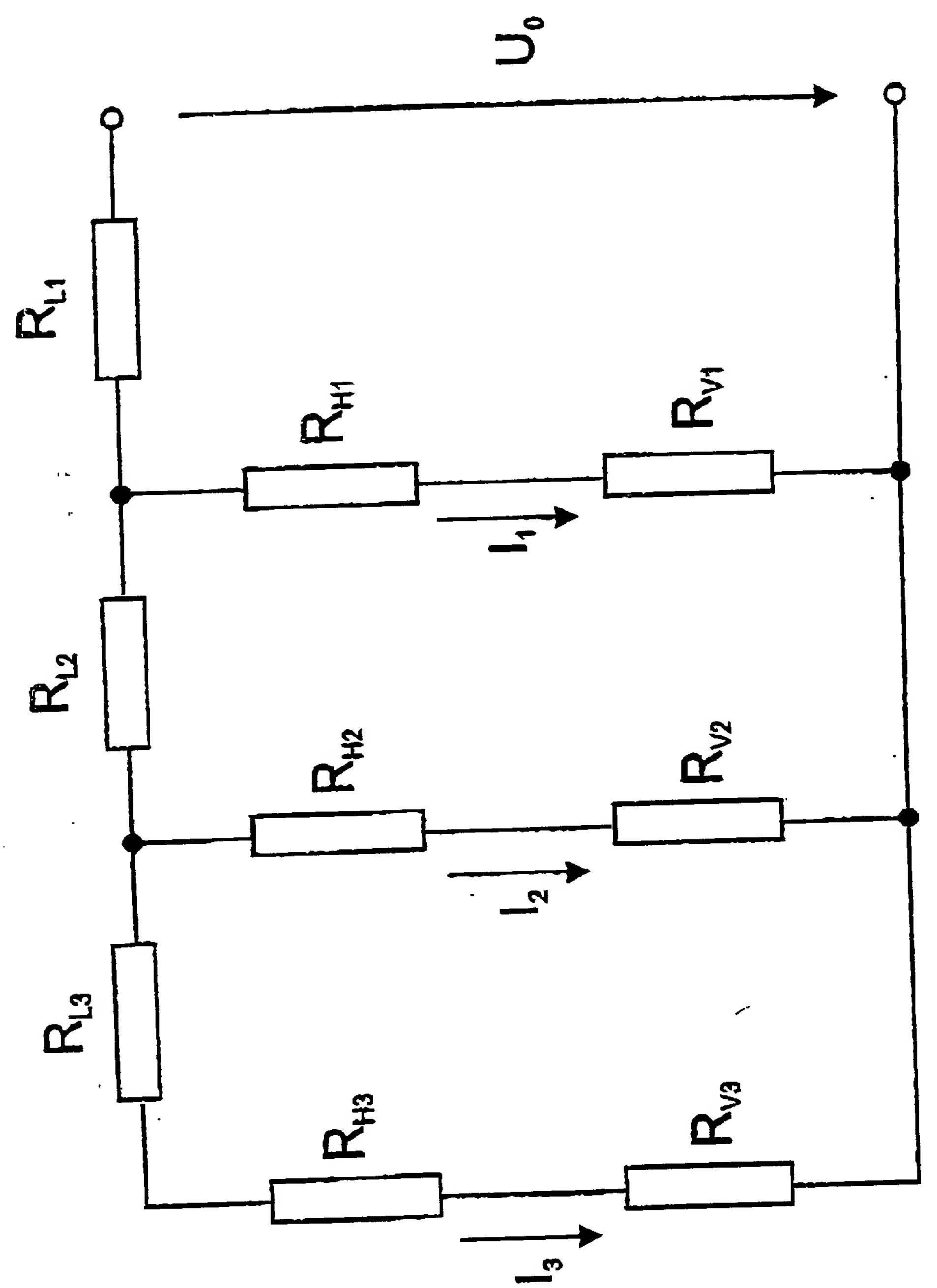

Fig. 2b

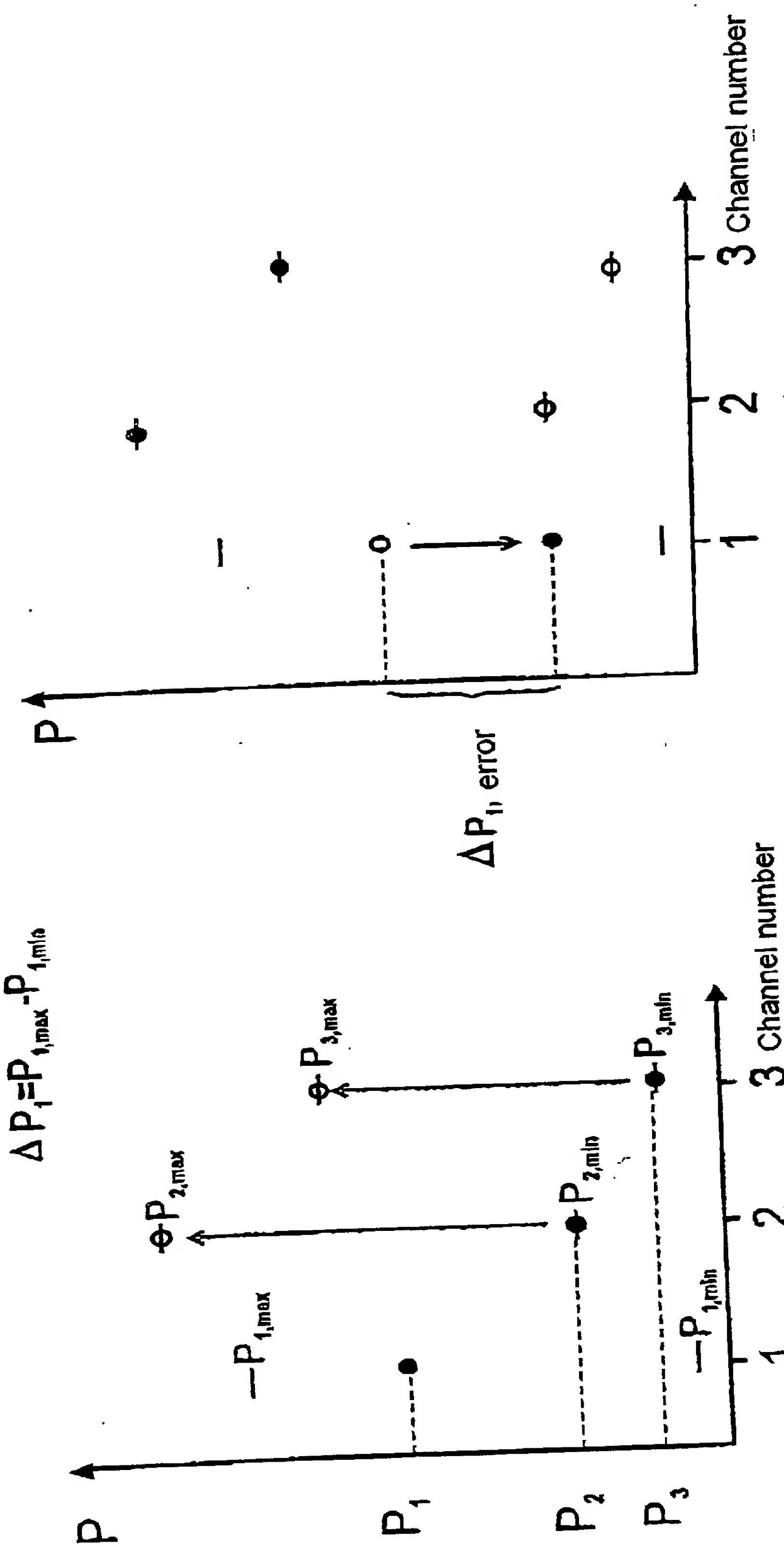
P
Channel number
1
2
3
$\Delta P_{1, error}$
P
P_1
P_2
P_3
$\Delta P_1 = P_{1,max} - P_{1,min}$
$P_{1,max}$
$P_{2,max}$
$P_{3,max}$
$P_{2,min}$
$P_{3,min}$
$P_{1,min}$
1
2
3
Channel number

Fig. 2c

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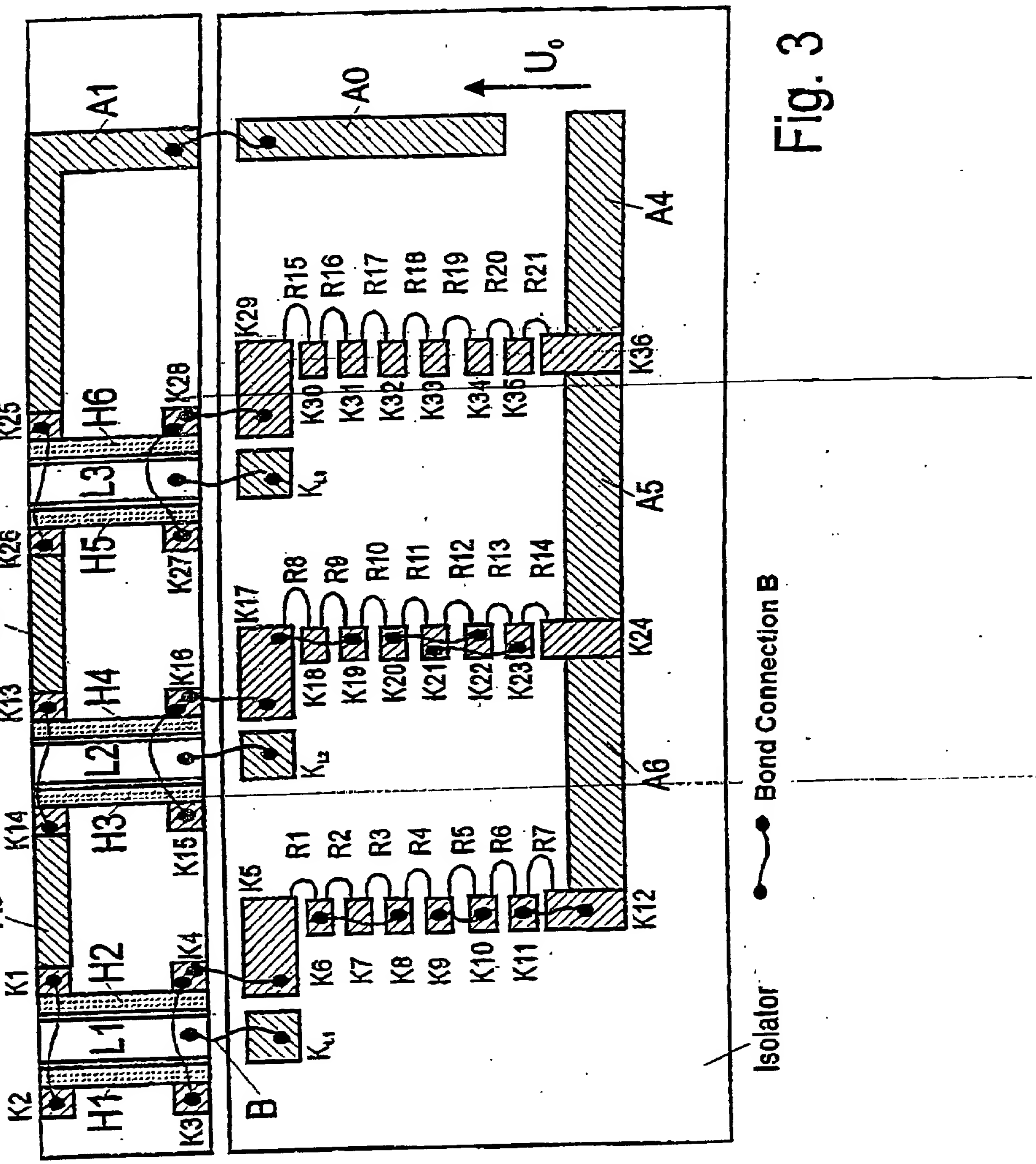

Fig. 3

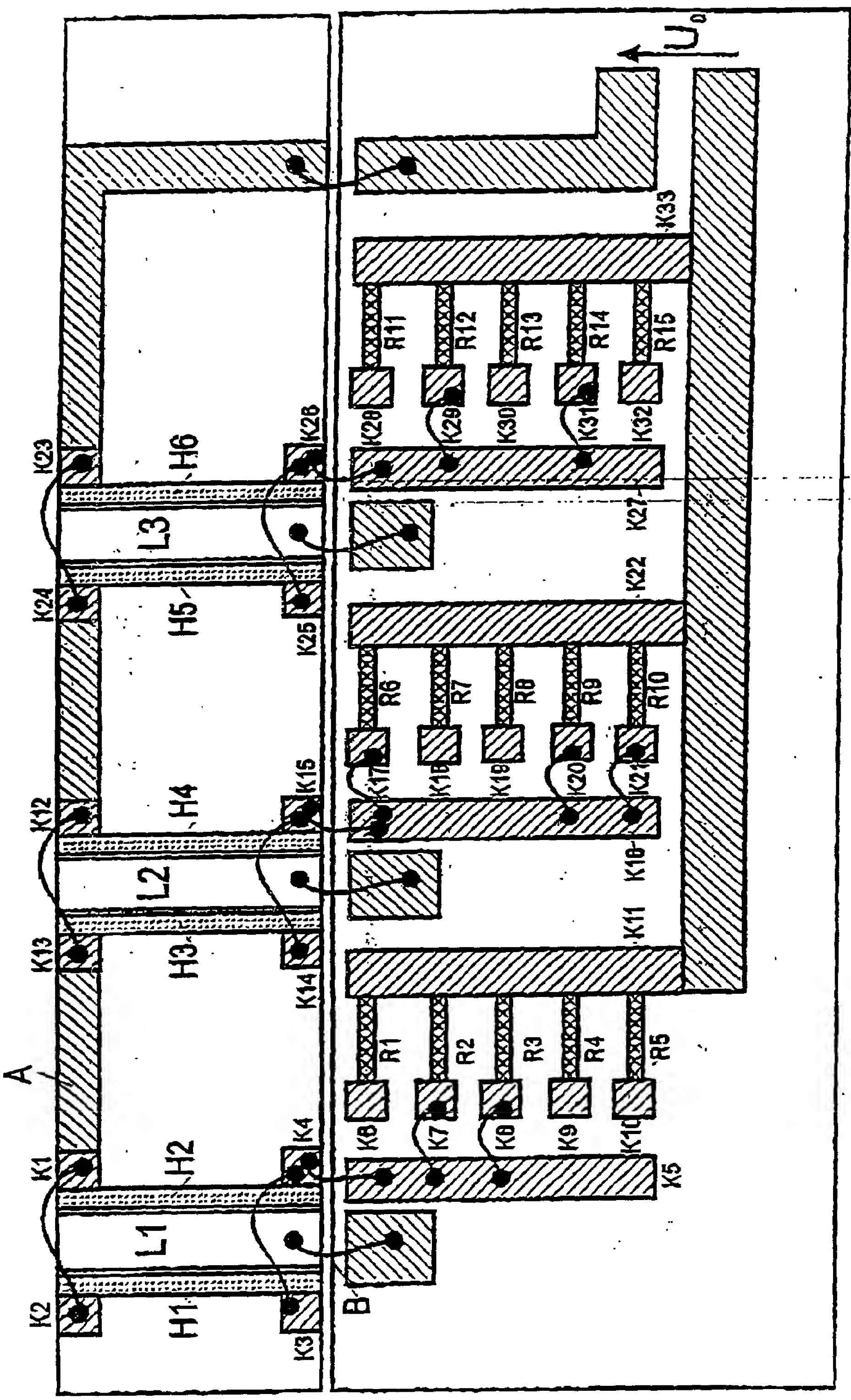

Fig. 4a

Bond Connection B

Relationship between adjusted binary value (index) and heat output

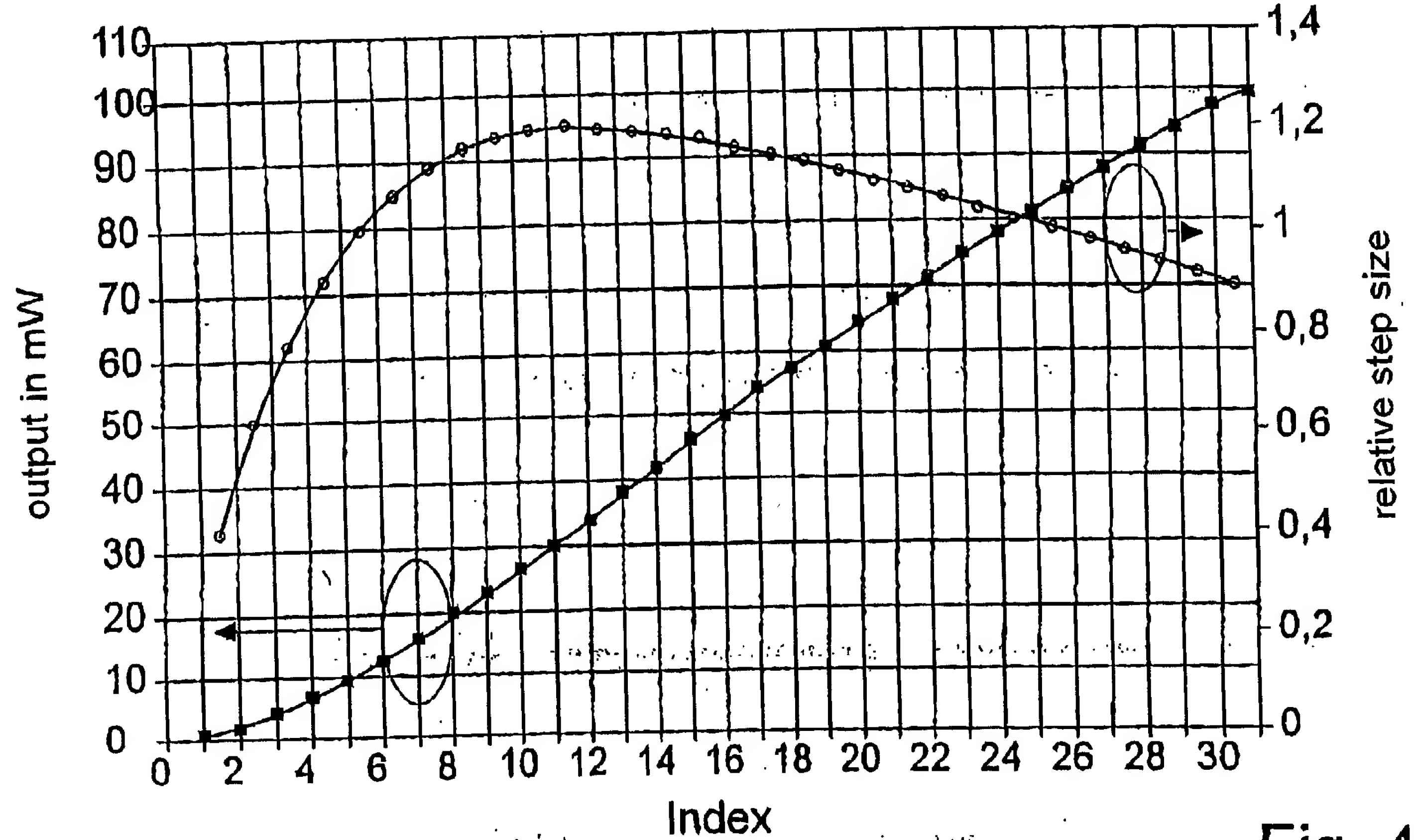

Fig. 4b

Relationship between adjusted binary value (index) and heat output

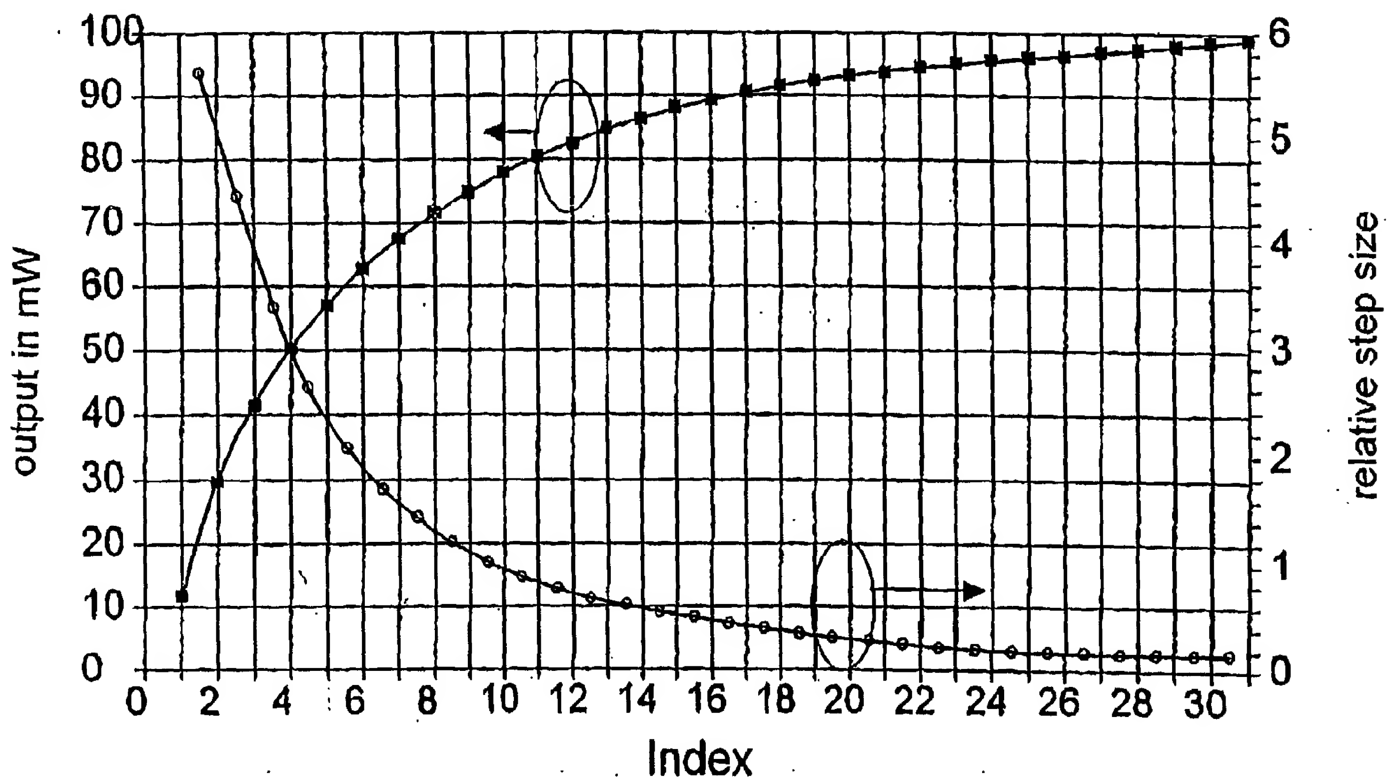

Fig. 4c

Relationship between adjusted binary value (index) and heat output

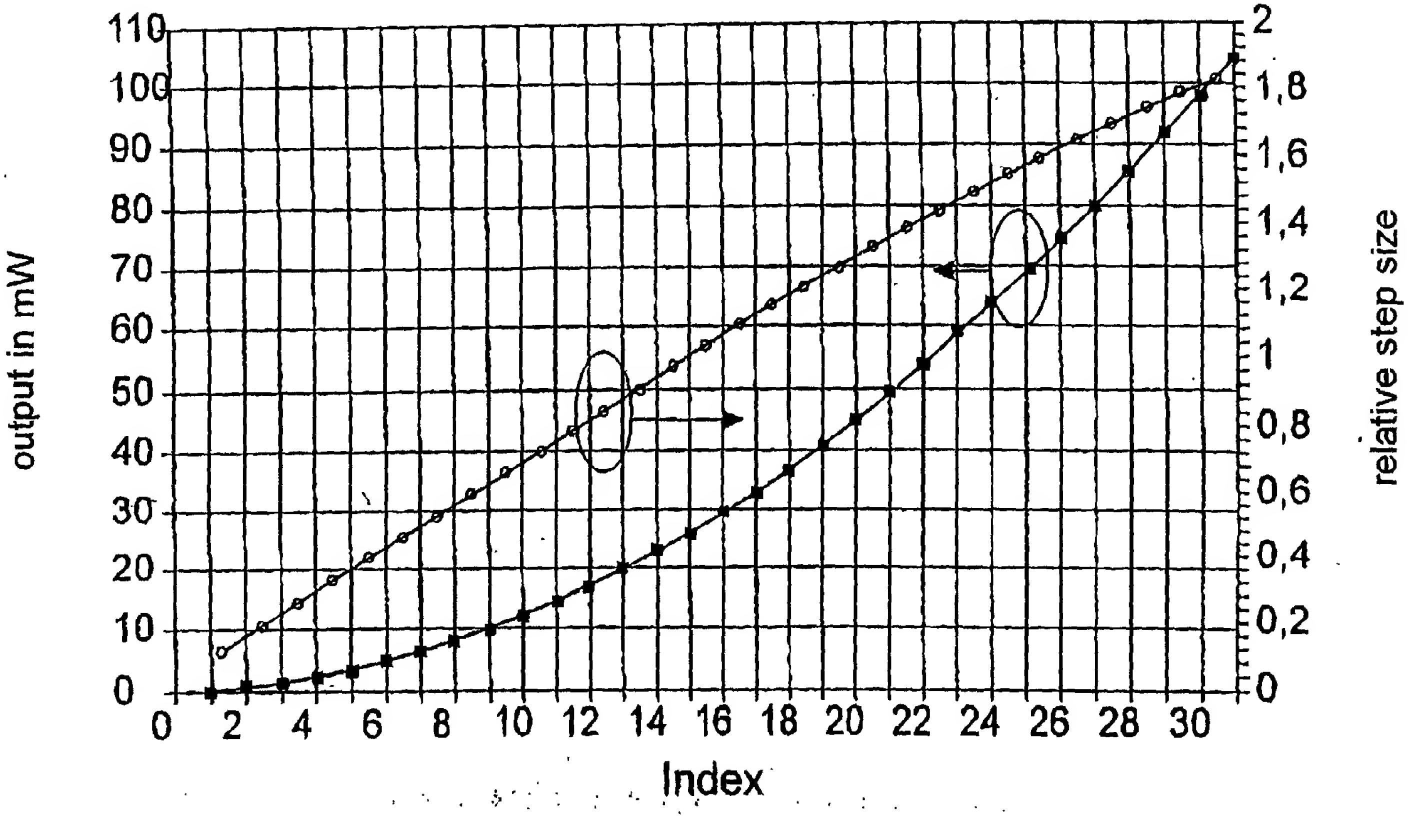

Fig. 4d

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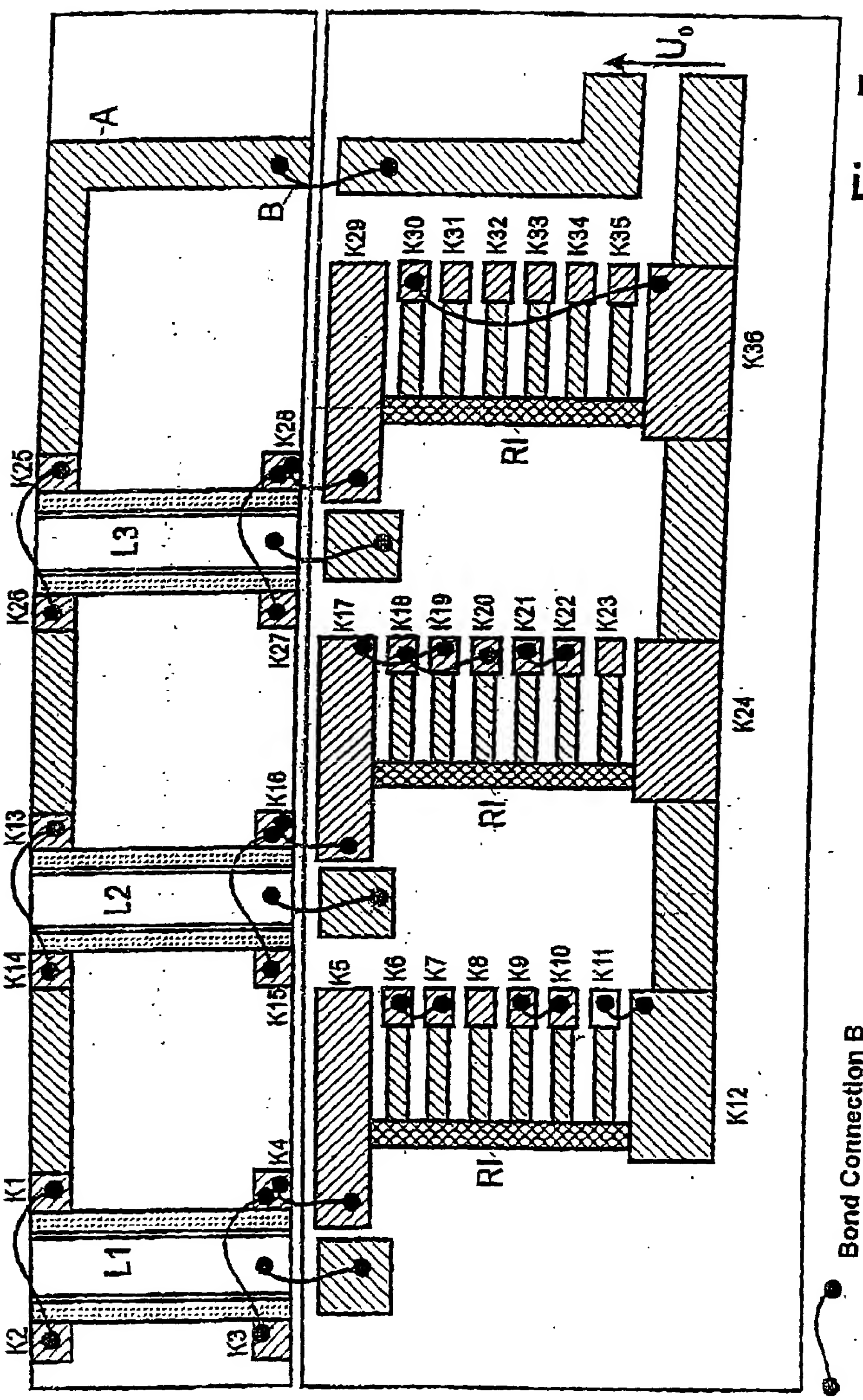


Fig. 5a

Relationship between adjusted binary value (index) and heat output for exemplary embodiment 5a

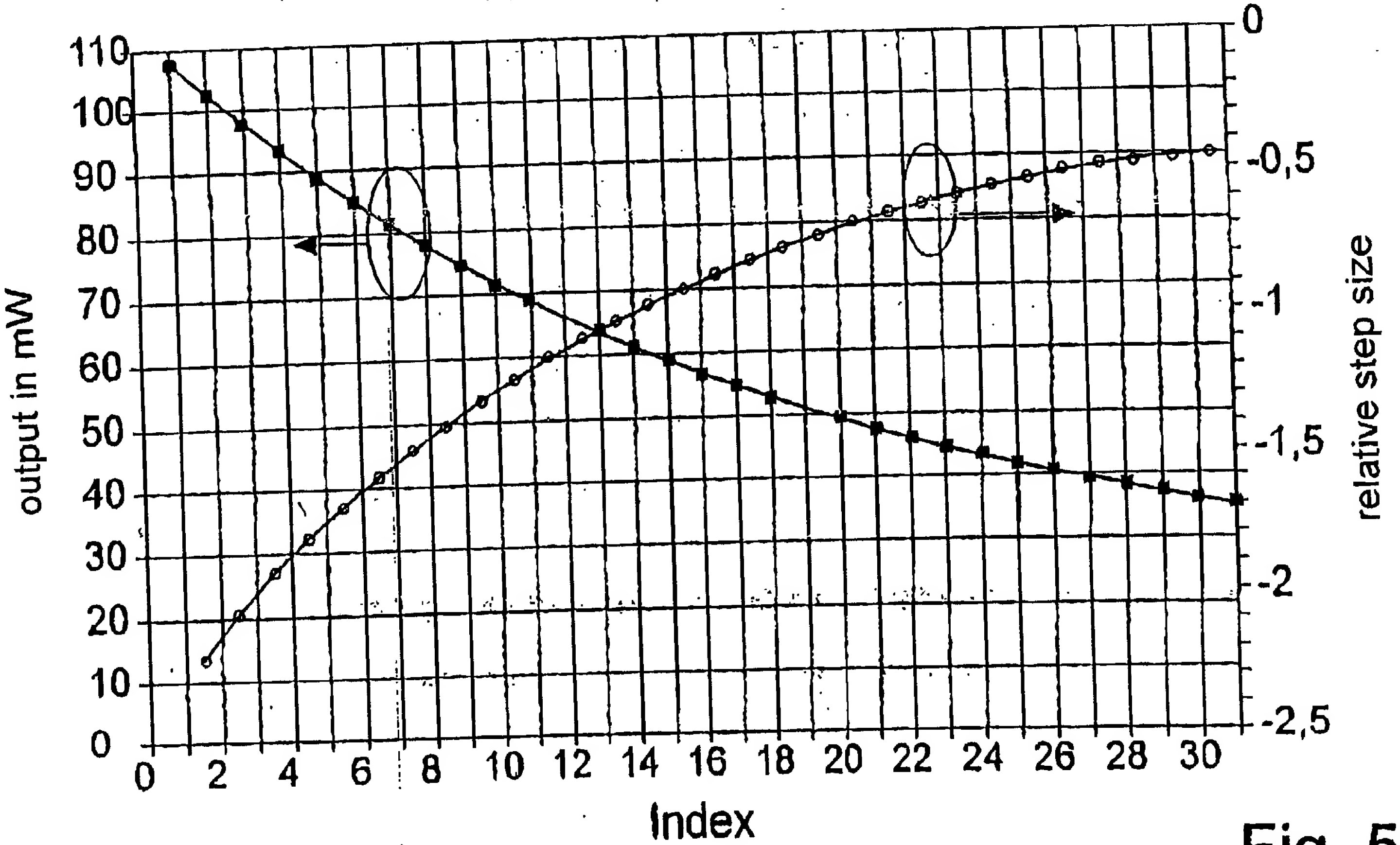
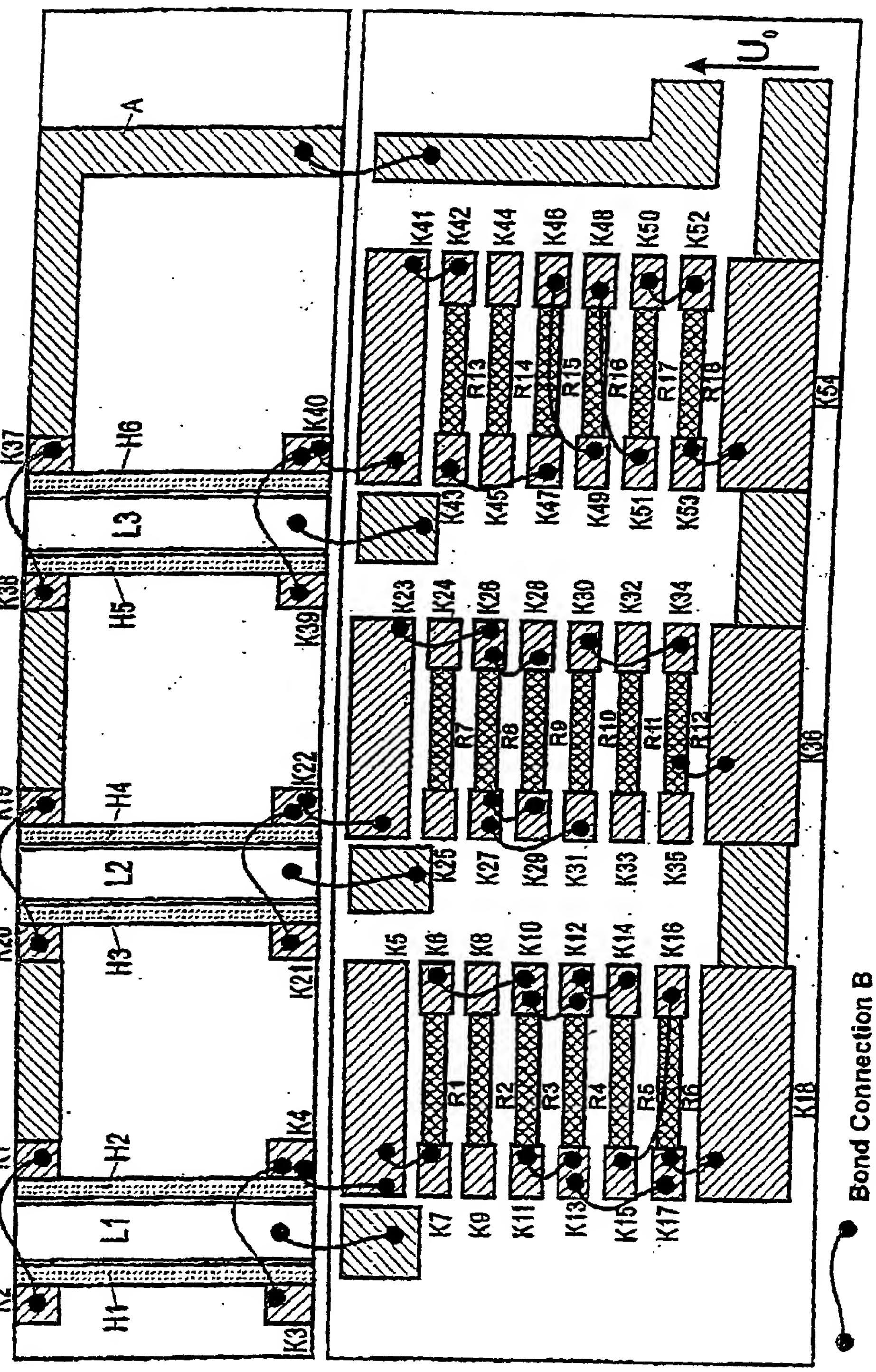


Fig. 5b


A
B
L1
L2
L3
H1
H2
H3
H4
H5
H6
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K5
K6
K7
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K29
K30
K31
K32
K33
K34
K35
K36
K37
K38
K39
K40
K41
K42
K43
K44
K45
K46
K47
K48
K49
K50
K51
K52
K53
K54
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
R15
R16
R17
R18
U_0
Bond Connection B

Fig. 6

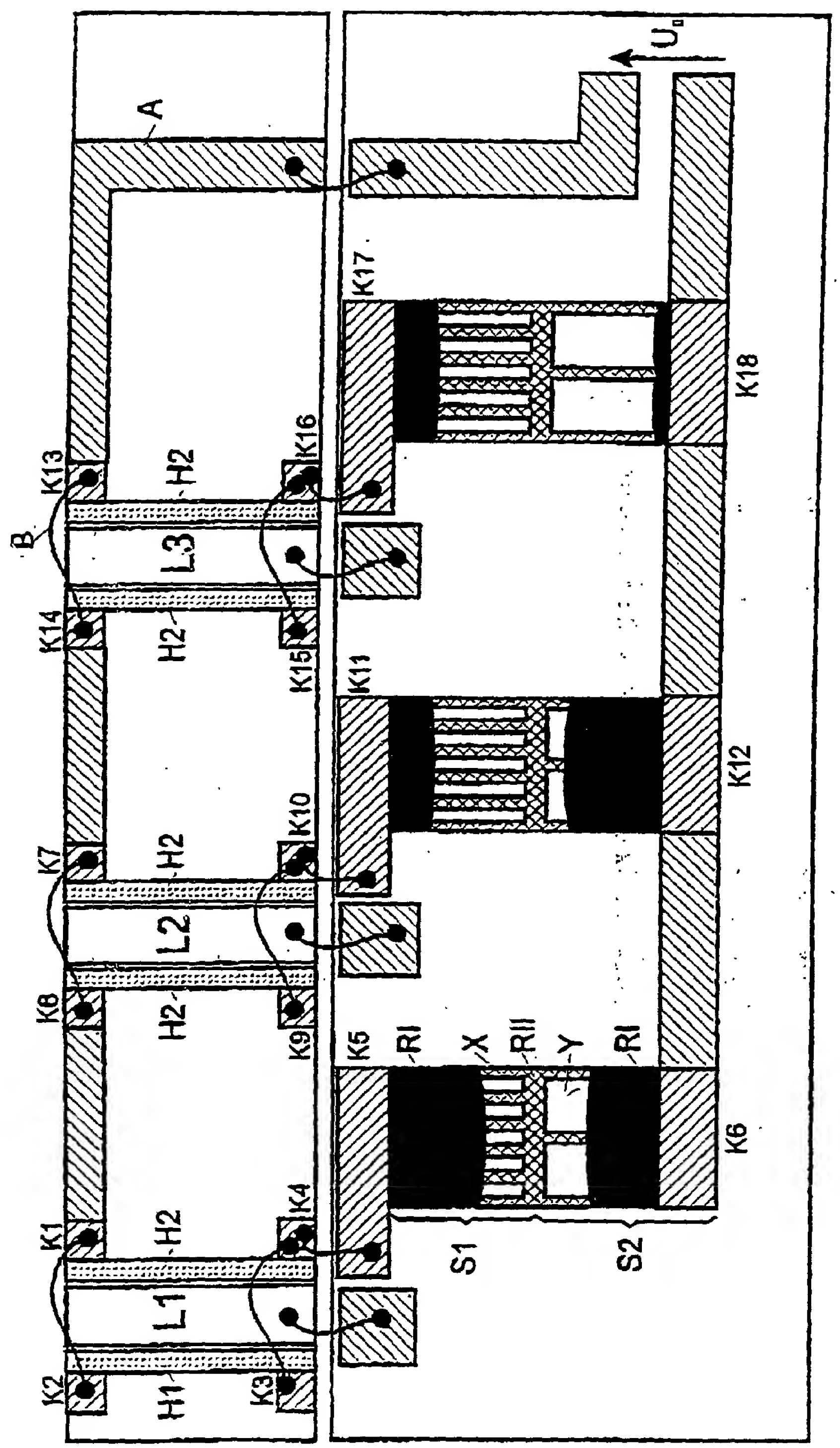
A
B
K1
K2
K3
K4
K5
K6
K7
K8
K9
K10
K11
K12
K13
K14
K15
K16
K17
K18
H1
H2
L1
L2
L3
RI
RII
X
Y
S1
S2
U

Fig. 7

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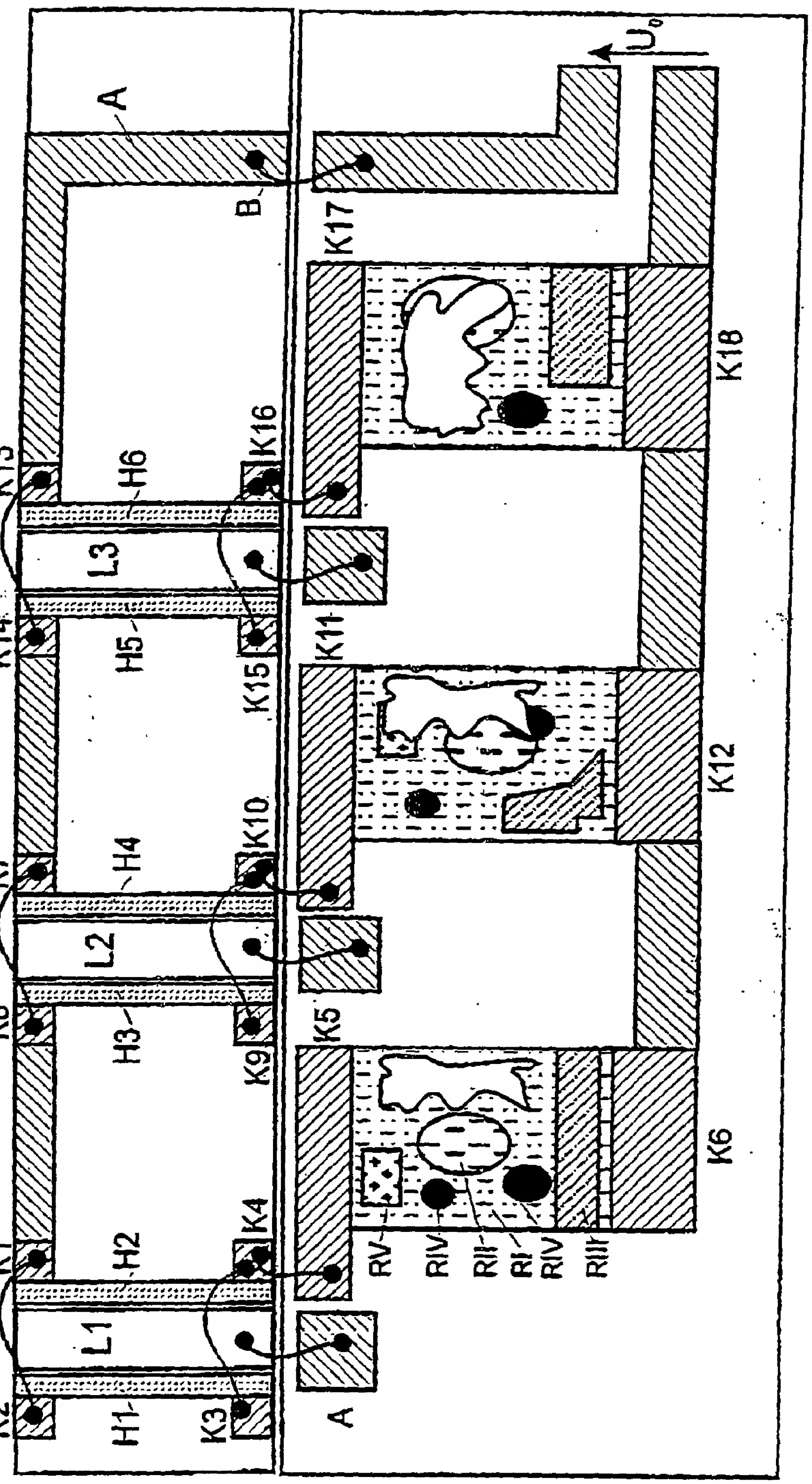
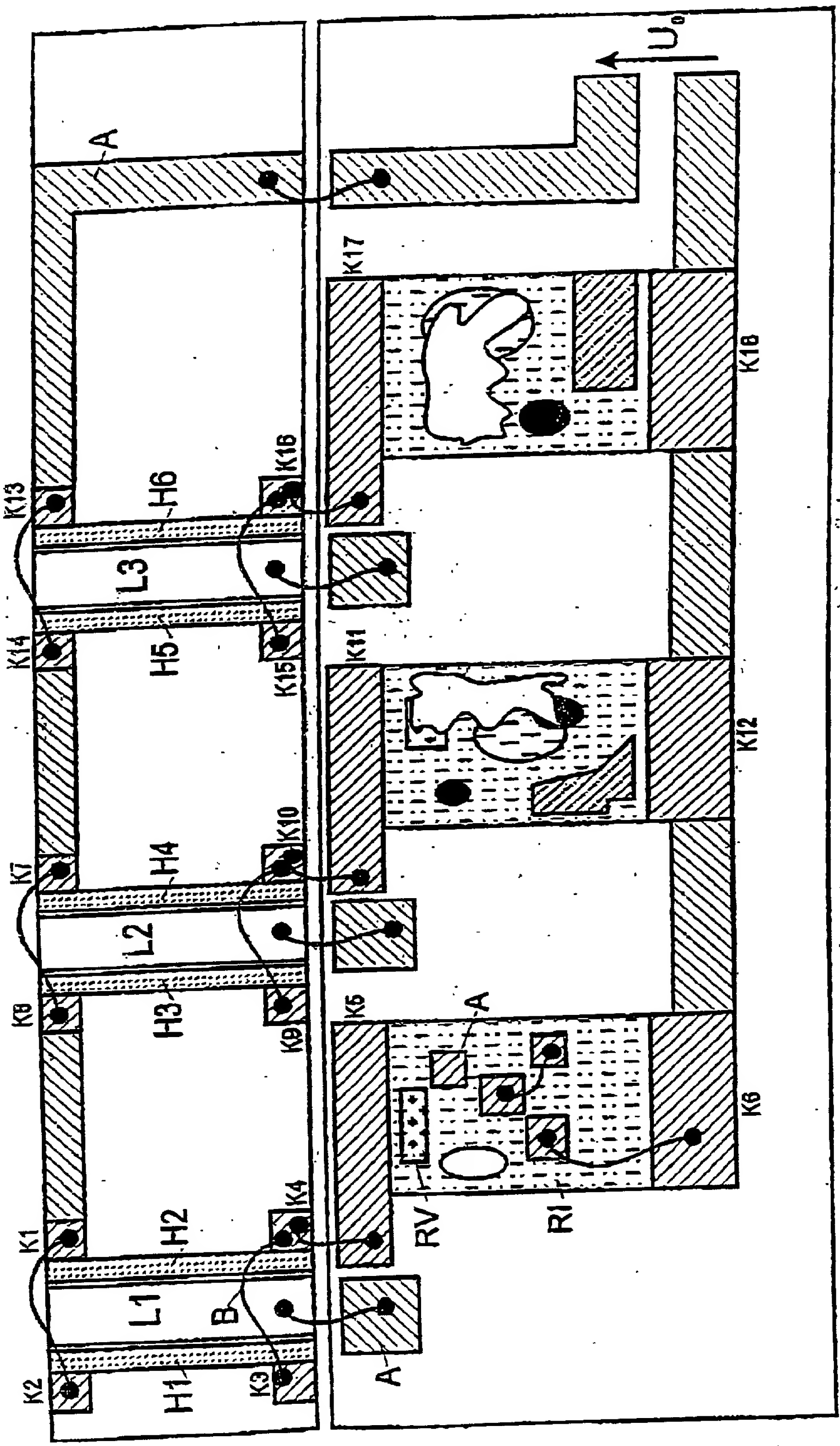


Fig. 8



Bond Connection B

Fig. 9

09/555662

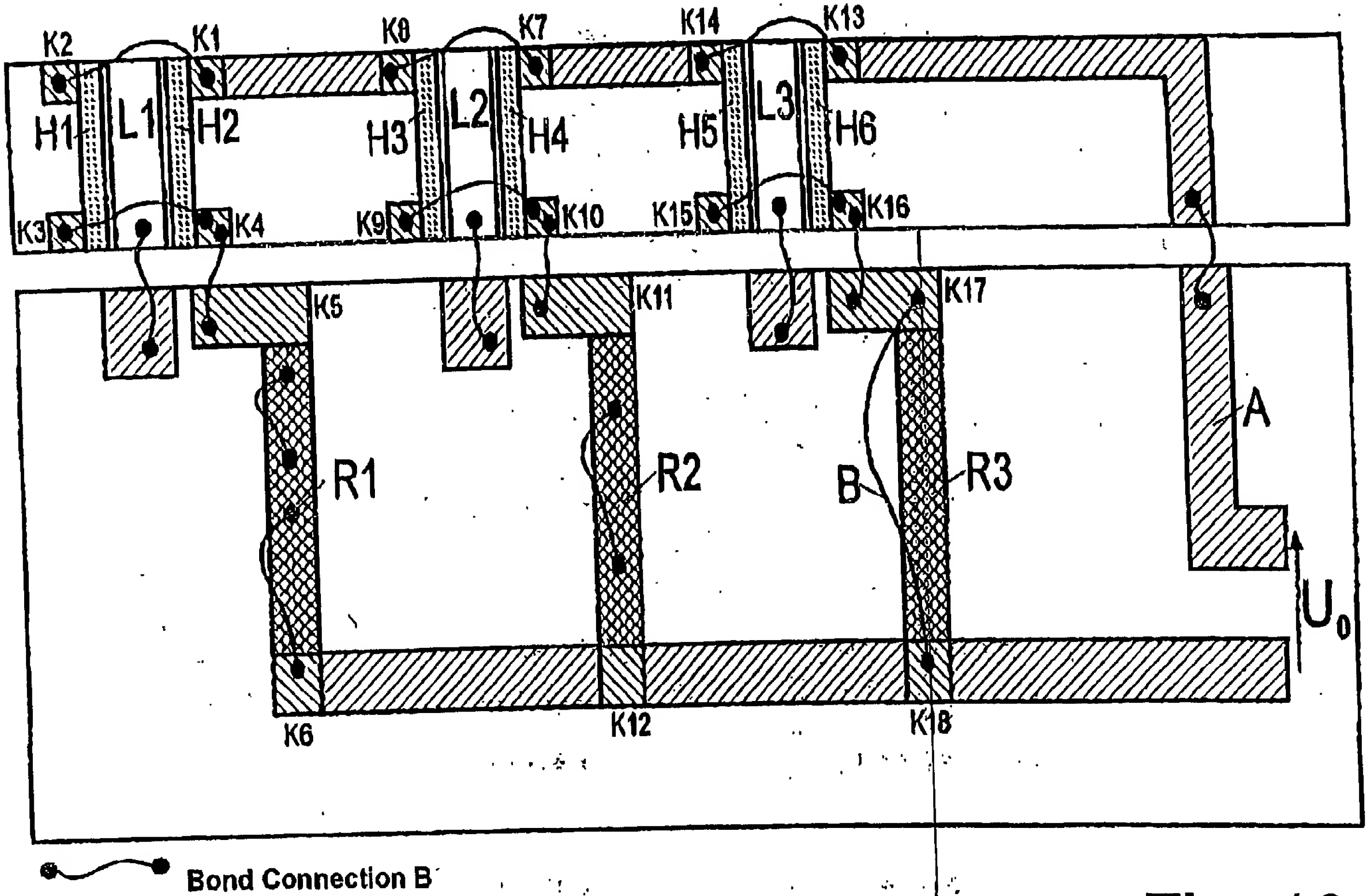


Fig. 10

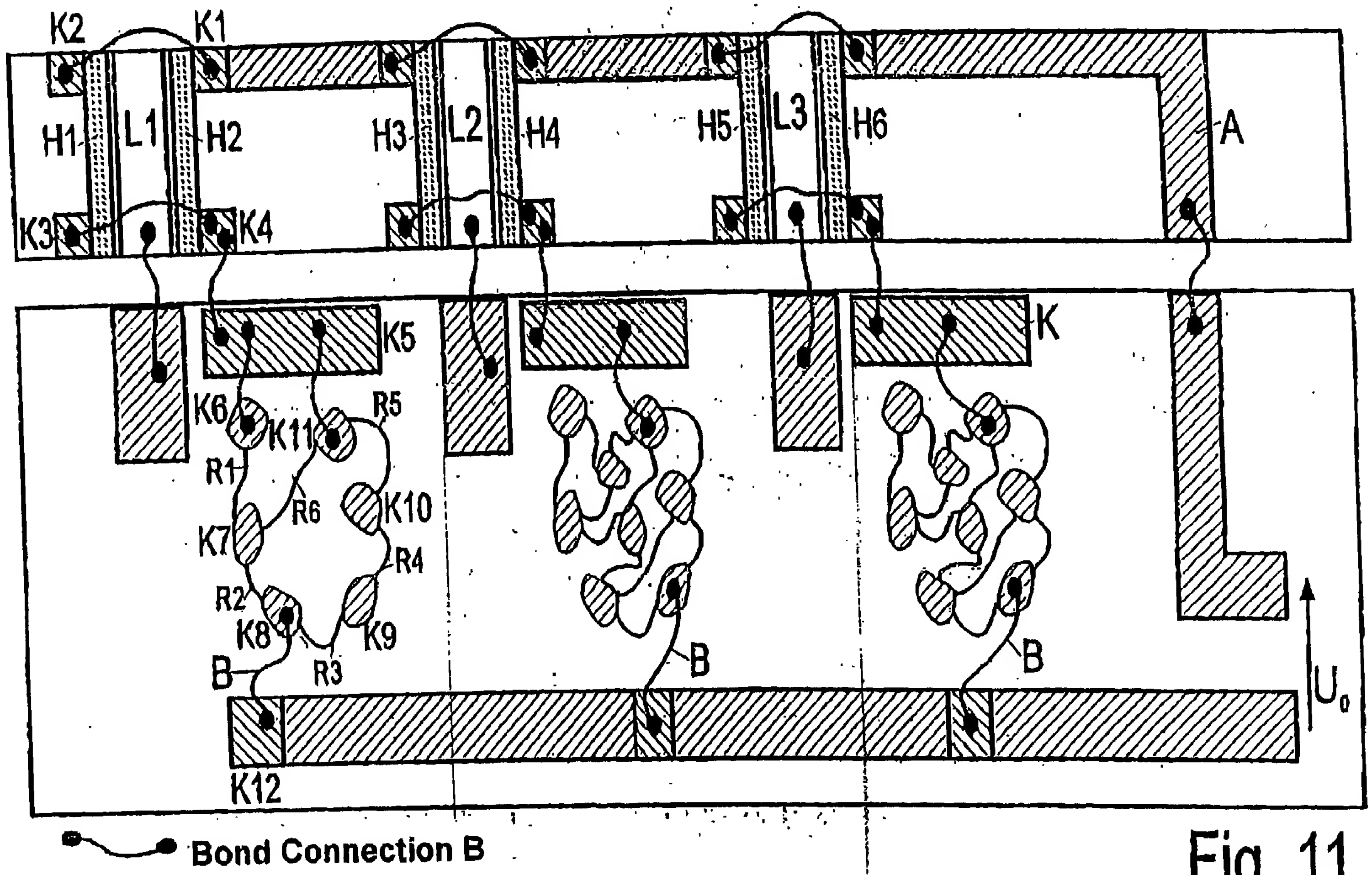

K2
K1
H1
L1
H2
H3
L2
H4
H5
L3
H6
A
K3
K4
K5
K
K6
K11
R5
R1
R6
K10
K7
R4
R2
K8
K9
R3
B
K12
U0
Bond Connection B

Fig. 11

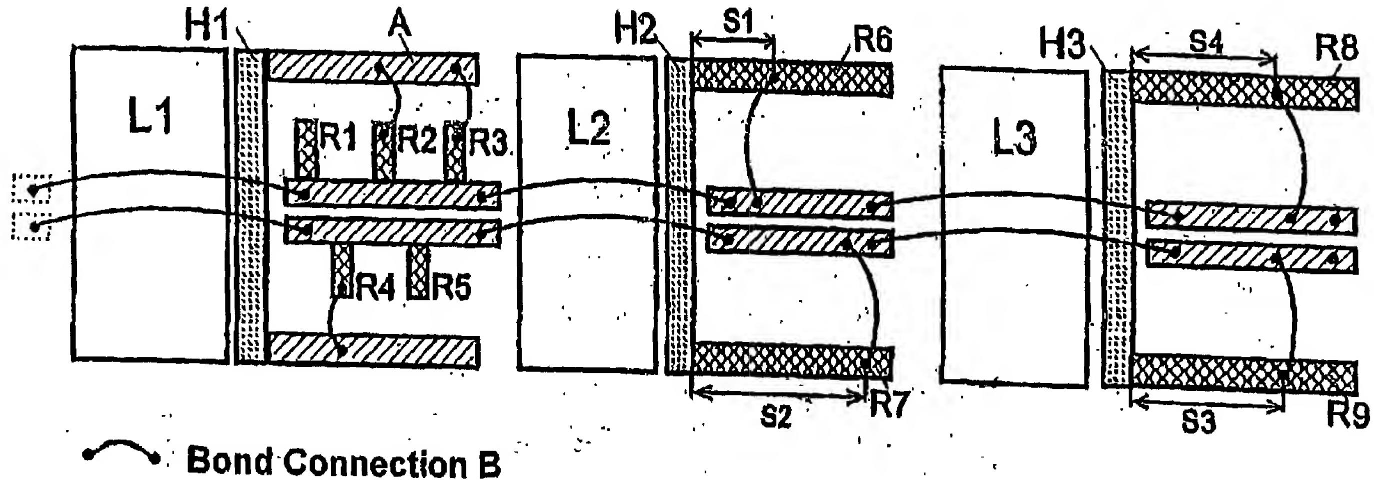

H1
A
L1
R1
R2
R3
R4
R5
H2
S1
R6
L2
S2
R7
H3
S4
R8
L3
S3
R9
Bond Connection B

Fig. 12a

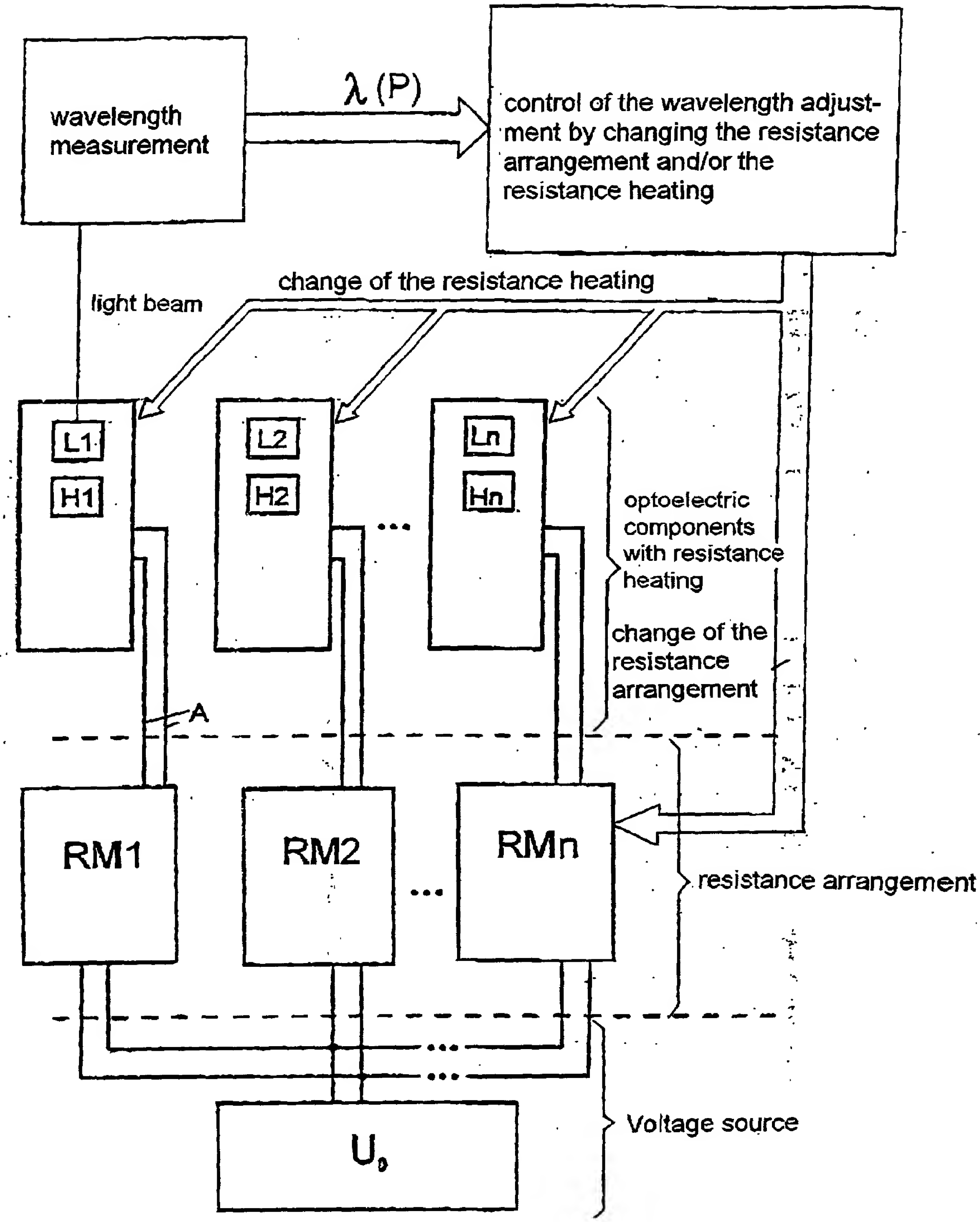
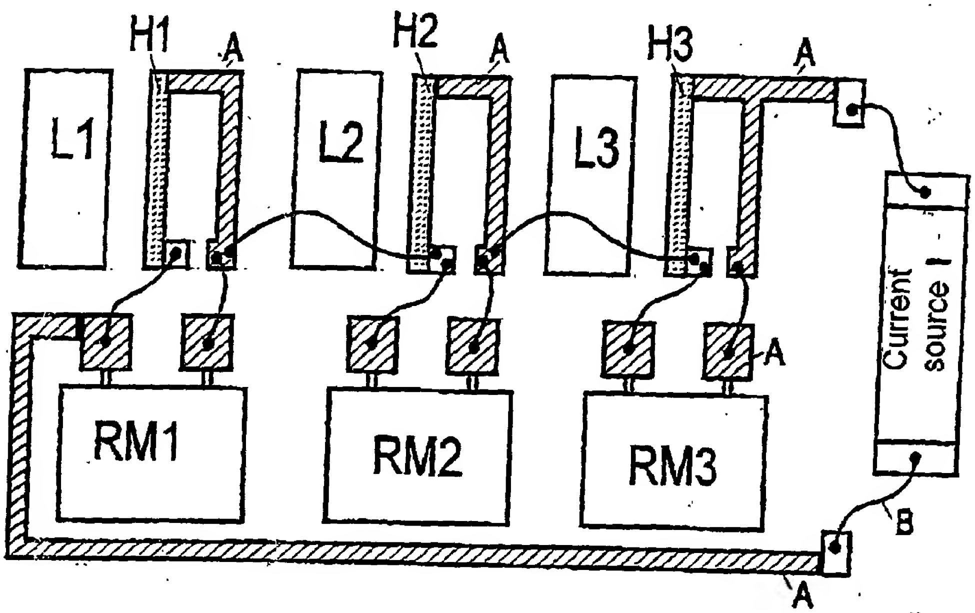

wavelength measurement
λ (P)
control of the wavelength adjustment by changing the resistance arrangement and/or the resistance heating
light beam
change of the resistance heating
L1
H1
L2
H2
Ln
Hn
optoelectric components with resistance heating
change of the resistance arrangement
A
RM1
RM2
RMn
resistance arrangement
U_0
Voltage source

Fig. 12b

Exemplary embodiment including current source



electrical circuit for exemplary embodiment

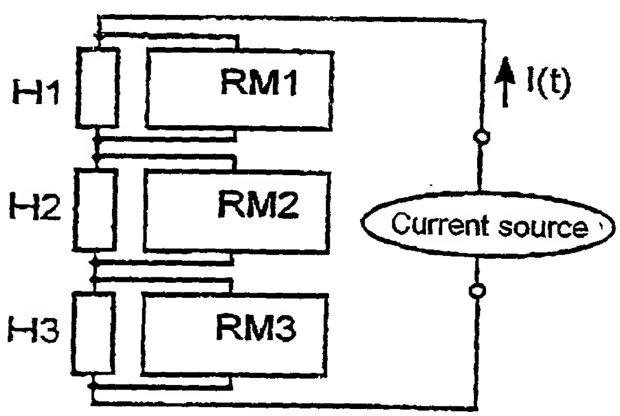


Fig.13

U.S. DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICE

DECLARATION AND POWER OF ATTORNEY	ATTORNEY'S DOCKET NO. **2345/117**

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name,

I believe I am an original, first, and joint inventor of the subject matter that is claimed and for which a patent is sought on the invention entitled **METHOD AND DEVICE FOR TUNING THE WAVELENGTH OF AN OPTOELECTRONIC COMPONENT ARRANGEMENT**, the specification of which was filed as International Application No. PCT/EP98/06911 on 21 October 1998 and is filed herewith in the United States Patent and Trademark Office.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, § 1.56(a).

PRIOR FOREIGN APPLICATION(S)

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

COUNTRY	APPLICATION NUMBER	DATE OF FILING (day, month, year)	DATE OF ISSUE (day, month, year)	PRIORITY CLAIMED UNDER 35 U S C. § 119
GERMANY	**197 55 457.1**	**1 December 1997**		**YES**

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorneys:
Richard L. Mayer (Reg. No. 22,490)
Erik R. Swanson (Reg. No. 40,833)

SEND CORRESPONDENCE, AND DIRECT TELEPHONE CALLS TO:

Richard L. Mayer
KENYON & KENYON
One Broadway
New York, New York 10004
(212) 425-7200 (phone)
(212) 425-5288 (facsimile)

EM360466583US

I declare that all statements made herein of my own knowledge are true and all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under § 1001 of Title 18 of the United States Code and that such willful statements may jeopardize the validity of the application or any patent issuing thereon.

120

FULL NAME OF INVENTOR	FAMILY NAME **HILLMER**	FIRST GIVEN NAME **Hartmut**	SECOND GIVEN NAME
RESIDENCE & CITIZENSHIP	CITY & ZIP CODE **D-34128 Kassel**	STATE OR FOREIGN COUNTRY **Germany** DEX	COUNTRY OF CITIZENSHIP **Germany**
POST OFFICE ADDRESS	POST OFFICE ADDRESS **An den Rehwiesen 16**	CITY & ZIP CODE **D-34128 Kassel**	STATE OR FOREIGN COUNTRY **Germany**
Signature		Date Febr. 15, 2000	
FULL NAME OF INVENTOR	FAMILY NAME **KLEPSER**	FIRST GIVEN NAME **Bernd**	SECOND GIVEN NAME
RESIDENCE & CITIZENSHIP	CITY & ZIP CODE **D-98617 Meiningen**	STATE OR FOREIGN COUNTRY **Germany**	COUNTRY OF CITIZENSHIP **Germany**
POST OFFICE ADDRESS	POST OFFICE ADDRESS **Schönen Aussicht 14**	CITY & ZIP CODE **D-98617 Meiningen**	STATE OR FOREIGN COUNTRY **Germany**
Signature		Date	

I declare that all statements made herein of my own knowledge are true and all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under § 1001 of Title 18 of the United States Code and that such willful statements may jeopardize the validity of the application or any patent issuing thereon.

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RESIDENCE & CITIZENSHIP	CITY & ZIP CODE **D-34128 Kassel**	STATE OR FOREIGN COUNTRY **Germany**	COUNTRY OF CITIZENSHIP **Germany**
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POST OFFICE ADDRESS	POST OFFICE ADDRESS **Schönen Aussicht 14**	CITY & ZIP CODE **D-98617 Meiningen**	STATE OR FOREIGN COUNTRY **Germany**
Signature	B Klepser	Date	03.04.00